

CFP Indicators

Testing stability of indicator $\frac{F}{F_{MSY}}$ outside EU waters

Ernesto Jardim¹

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

*Corresponding author 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 F/Fmsy trends outside EU waters

```
df0 <- subset(isa, (EcoRegion %in% c("Arctic Ocean", "Greenland Sea", "Faroes", "Iceland Sea") | FishSt
df0$Fref <- as.numeric(df0$FMSY)
df0 <- transform(df0, indF = FishingPressure/Fref, sfFind=!is.na(FishingPressure/Fref))
idx <- df0$FishingPressureDescription %in% c("F", "F/Fmsy") & df0$sfFind
df0 <- df0[idx,]
df0$Year <- factor(df0$Year)
yrs <- levels(df0$Year)
nd <- data.frame(Year=factor(yrs))
# fit
fit <- glmer(indF ~ Year + (1|FishStock), data = df0, family = Gamma("log"),
  control=glmerControl(optimizer="nlminbwrap"))
summary(fit)

## Generalized linear mixed model fit by maximum likelihood
## (Laplace Approximation) [glmerMod]
## Family: Gamma ( log )
## Formula: indF ~ Year + (1 | FishStock)
## Data: df0
## Control: glmerControl(optimizer = "nlminbwrap")
##
##          AIC          BIC    logLik deviance df.resid
##    181.7      241.7     -72.8    145.7      189
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.0843 -0.5323 -0.0096  0.4314  4.7228
##
## Random effects:
## Groups   Name                Variance Std.Dev.
## FishStock (Intercept) 0.1629    0.4036
## Residual              0.1138    0.3374
```

```
## Number of obs: 207, groups: FishStock, 13
##
## Fixed effects:
##           Estimate Std. Error t value Pr(>|z|)
## (Intercept)  0.23403    0.29110   0.804  0.42144
## Year2004     -0.02229    0.11358  -0.196  0.84442
## Year2005      0.02442    0.11359   0.215  0.82975
## Year2006     -0.09288    0.11368  -0.817  0.41392
## Year2007     -0.08789    0.11366  -0.773  0.43938
## Year2008     -0.06877    0.11381  -0.604  0.54568
## Year2009     -0.27161    0.11382  -2.386  0.01702 *
## Year2010     -0.22163    0.11388  -1.946  0.05162 .
## Year2011     -0.24368    0.11373  -2.143  0.03215 *
## Year2012     -0.23294    0.11373  -2.048  0.04054 *
## Year2013     -0.30667    0.11379  -2.695  0.00704 **
## Year2014     -0.30651    0.11379  -2.694  0.00707 **
## Year2015     -0.18779    0.11388  -1.649  0.09913 .
## Year2016     -0.19545    0.11395  -1.715  0.08632 .
## Year2017     -0.17557    0.11429  -1.536  0.12450
## Year2018     -0.09800    0.11695  -0.838  0.40203
## ---
## Signif. codes:
## 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

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

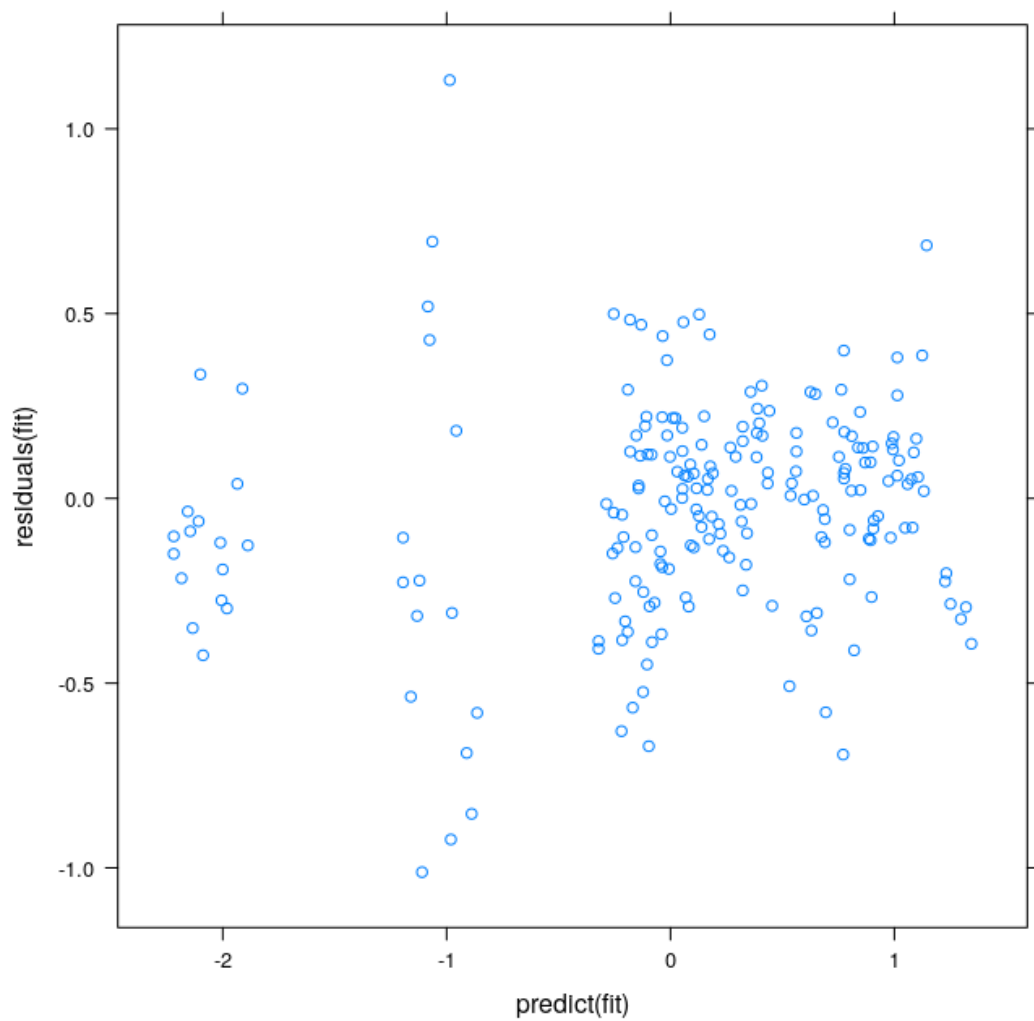


Figure 1: Homogeneity of variance in the GLMM for F/Fmsy

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

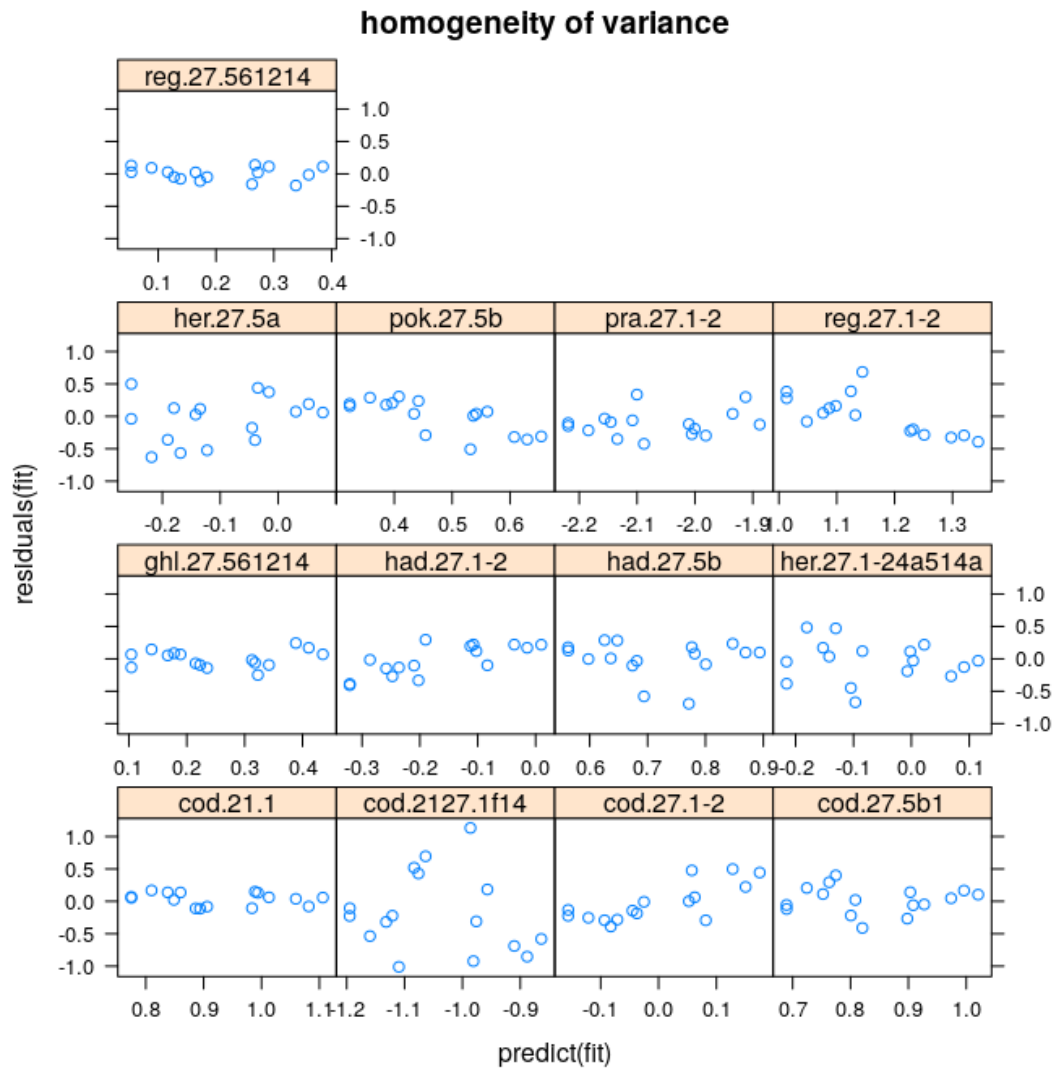


Figure 2: Homogeneity of variance by stock in the GLMM for F/Fmsy

```

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

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

```

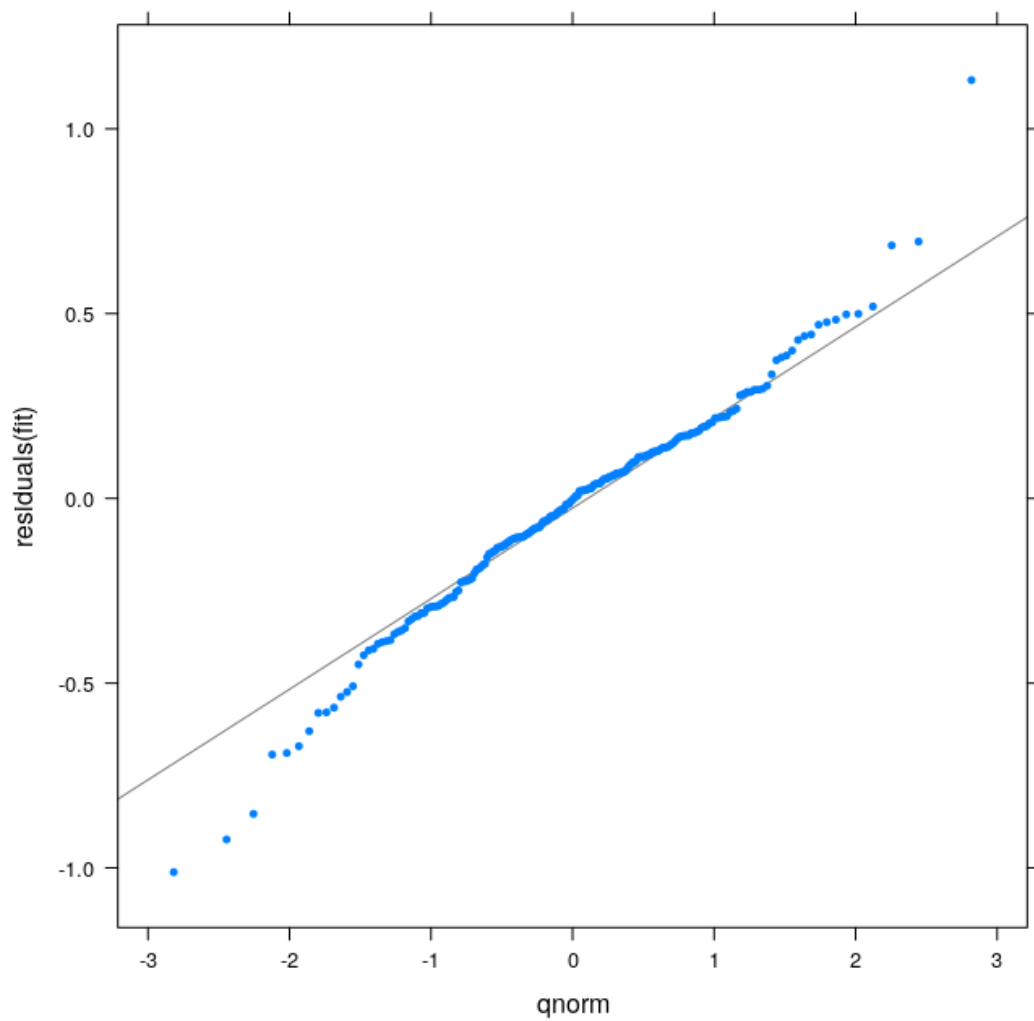


Figure 3: Normality of residuals in the GLMM for F/Fmsy

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

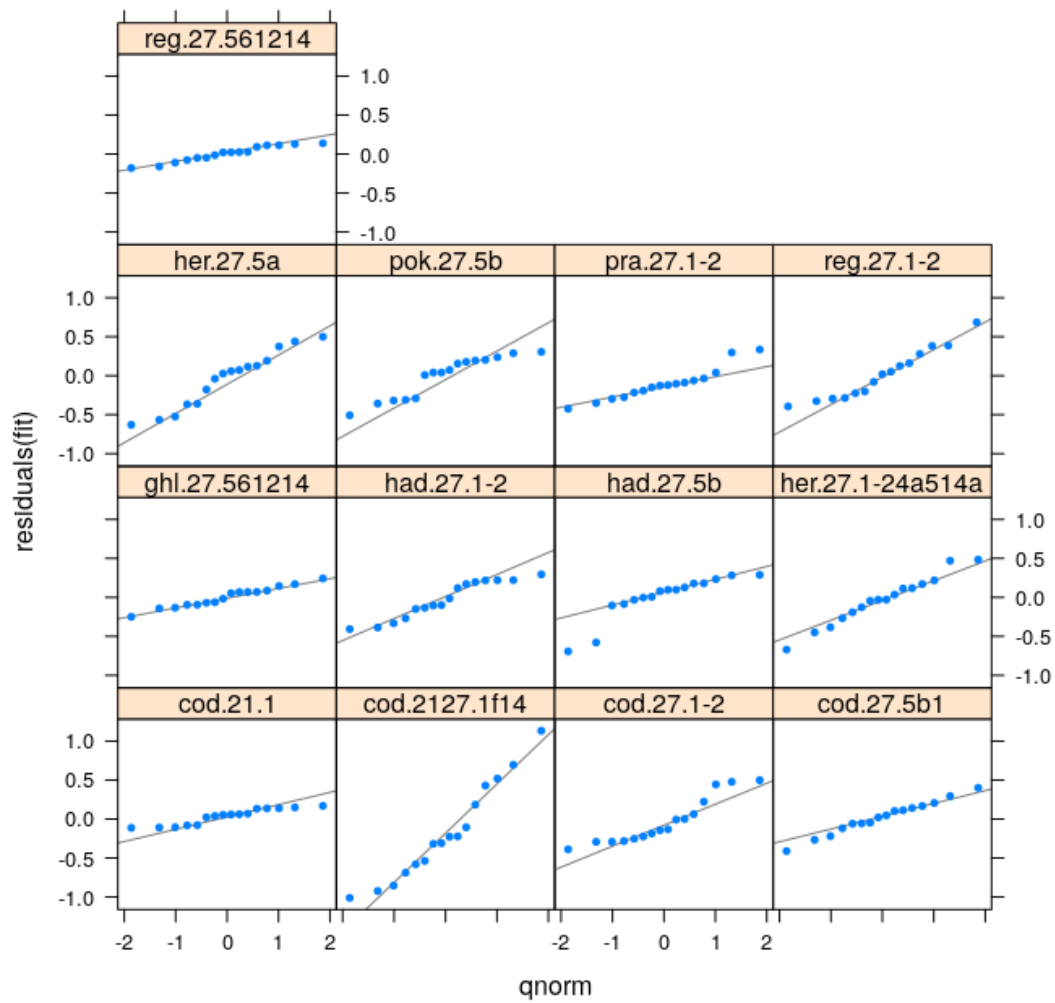


Figure 4: Normality of residuals by stock in the GLMM for F/F_{msy}

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

```
## $FishStock
```

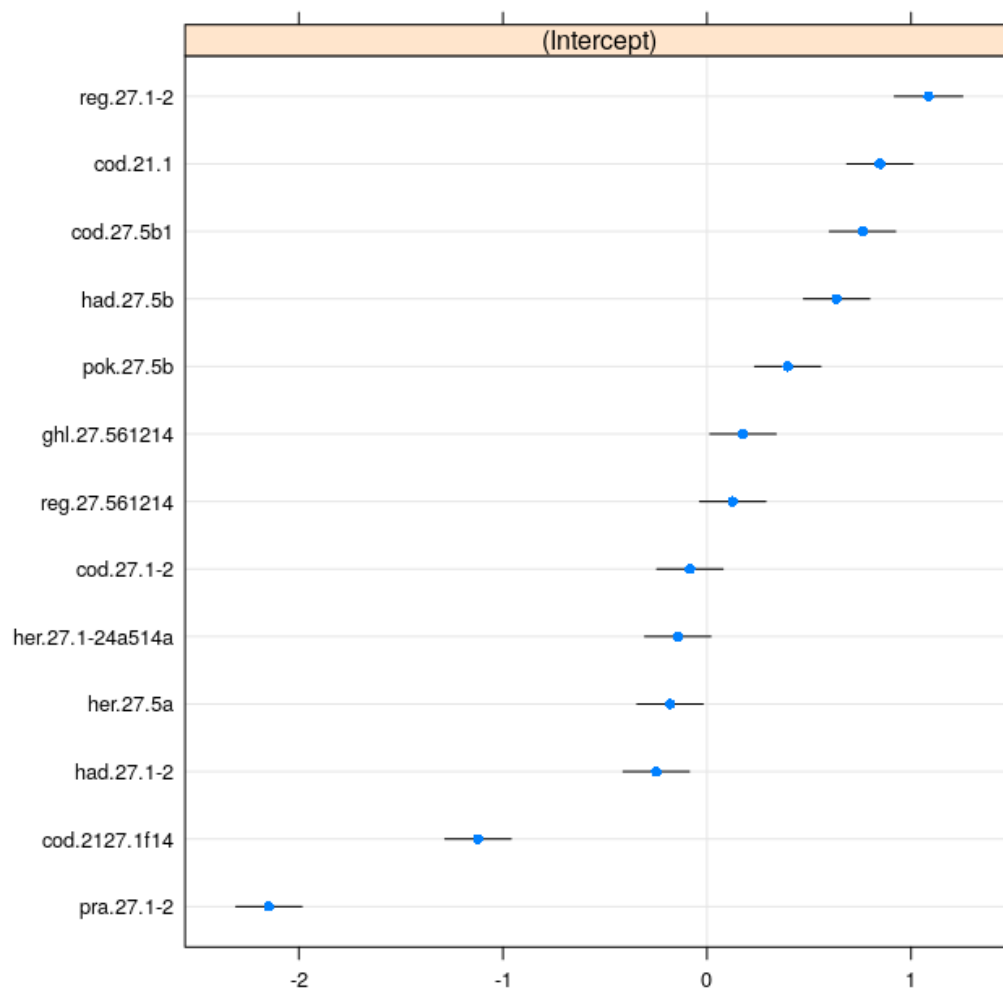



Figure 5: Random effects

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

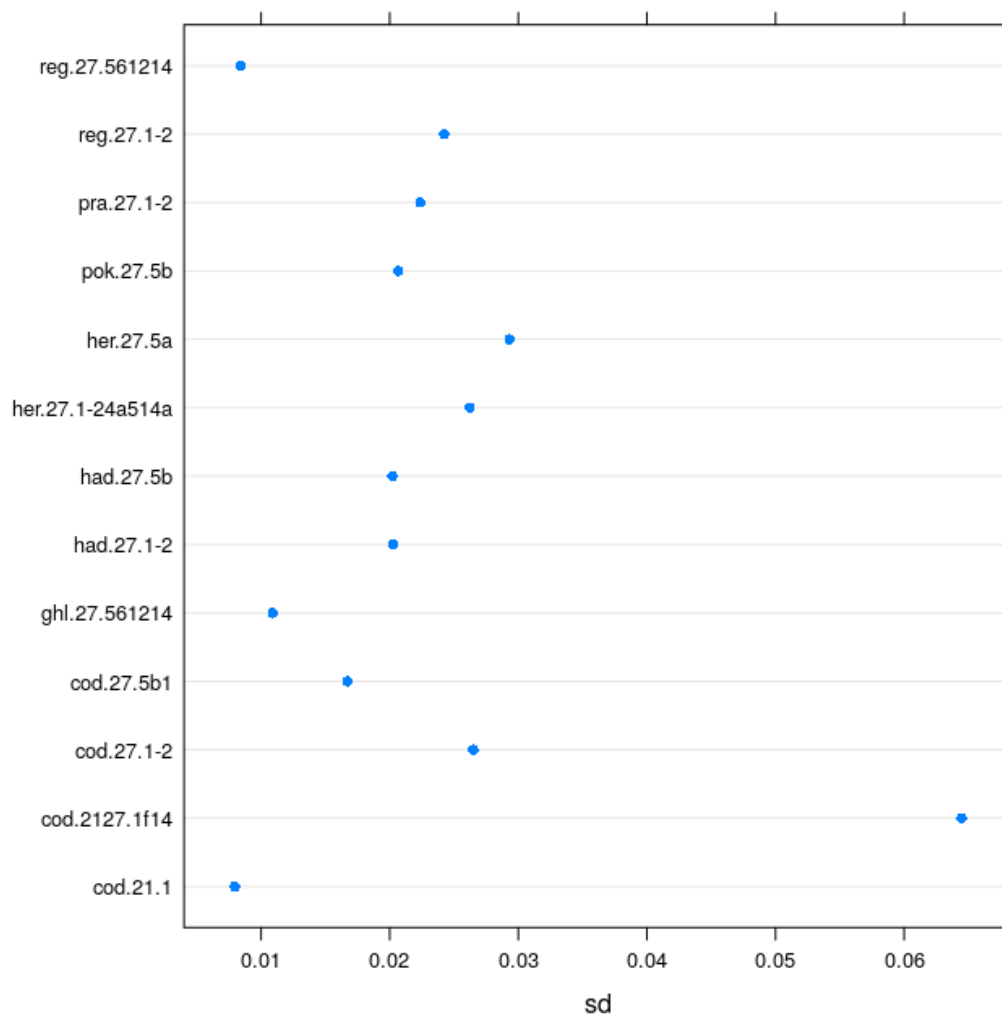
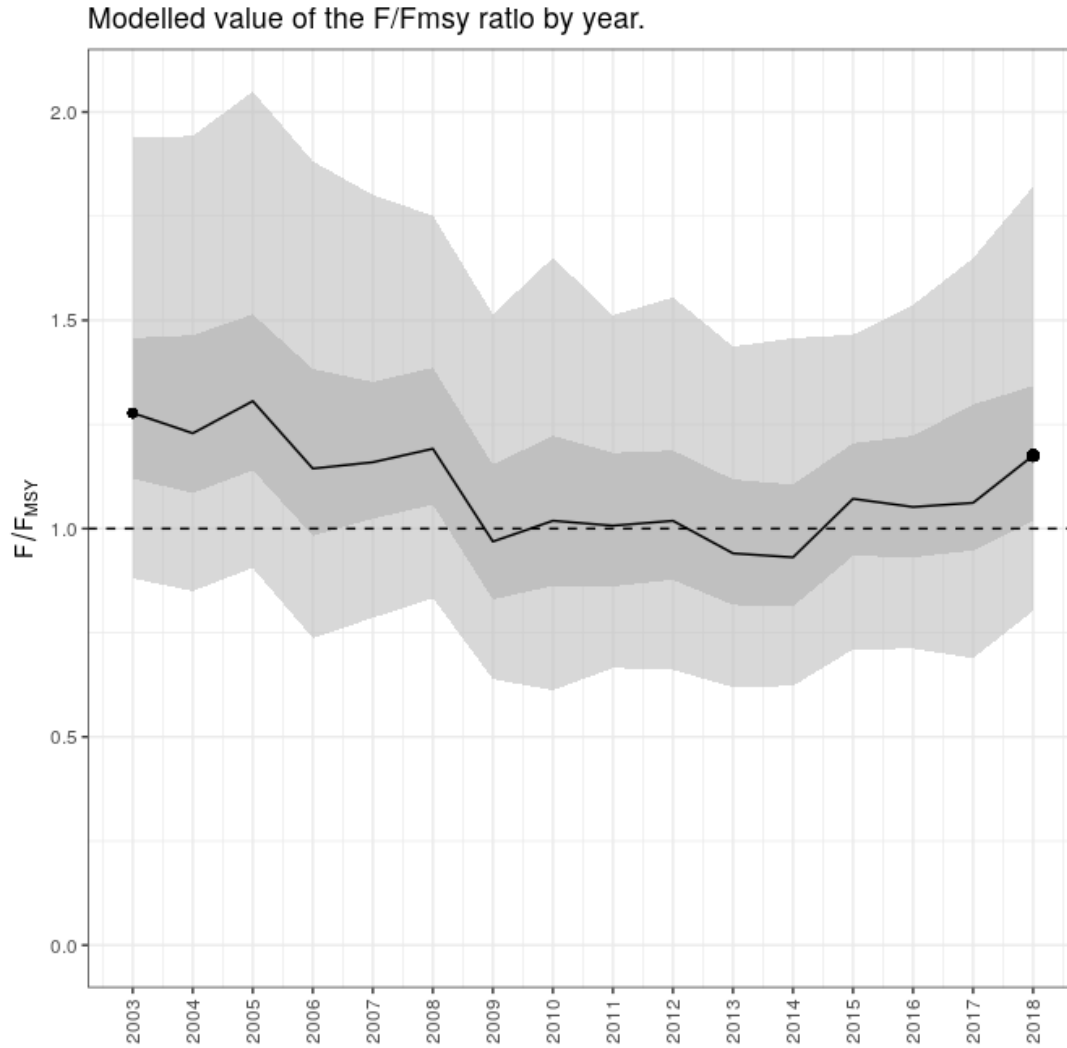


Figure 6: Influence on fixed effect "year" in the GLMM for F/Fmsy

```
# 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(indF ~ Year + (1|FishStock), data = df1, family = Gamma("log"),
    control=glmerControl(optimizer="nlminbwrap"))
  predict(fit, re.form=~0, type="response", newdata=nd)
}, 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(expression(F/FMSY)) + xlab("") +
theme(legend.position = "none") + sc + th +
ggtitle("Modelled value of the F/Fmsy ratio by year.")
```



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

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

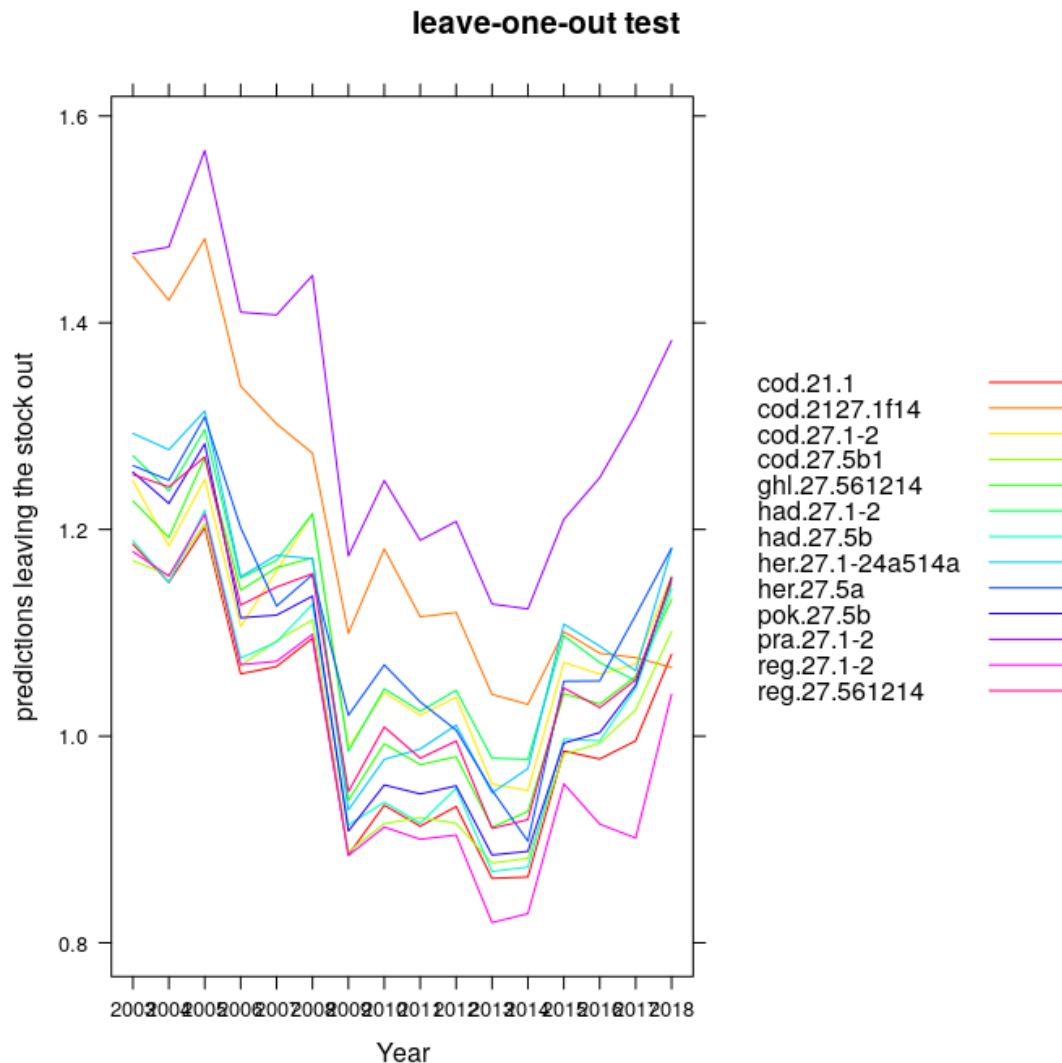
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
2.5%	0.88	0.85	0.91	0.74	0.79	0.83	0.64	0.61	0.67	0.66	0.62	0.62	0.71	0.71	0.69	0.80
25%	1.12	1.09	1.14	0.98	1.02	1.06	0.83	0.86	0.86	0.88	0.82	0.81	0.94	0.93	0.95	1.02
50%	1.28	1.23	1.31	1.14	1.16	1.19	0.97	1.02	1.01	1.02	0.94	0.93	1.07	1.05	1.06	1.18
75%	1.46	1.46	1.51	1.38	1.35	1.39	1.15	1.22	1.18	1.19	1.12	1.11	1.20	1.22	1.30	1.34
97.5%	1.94	1.94	2.05	1.88	1.80	1.75	1.51	1.65	1.51	1.56	1.44	1.46	1.47	1.54	1.65	1.82

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

```

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

```

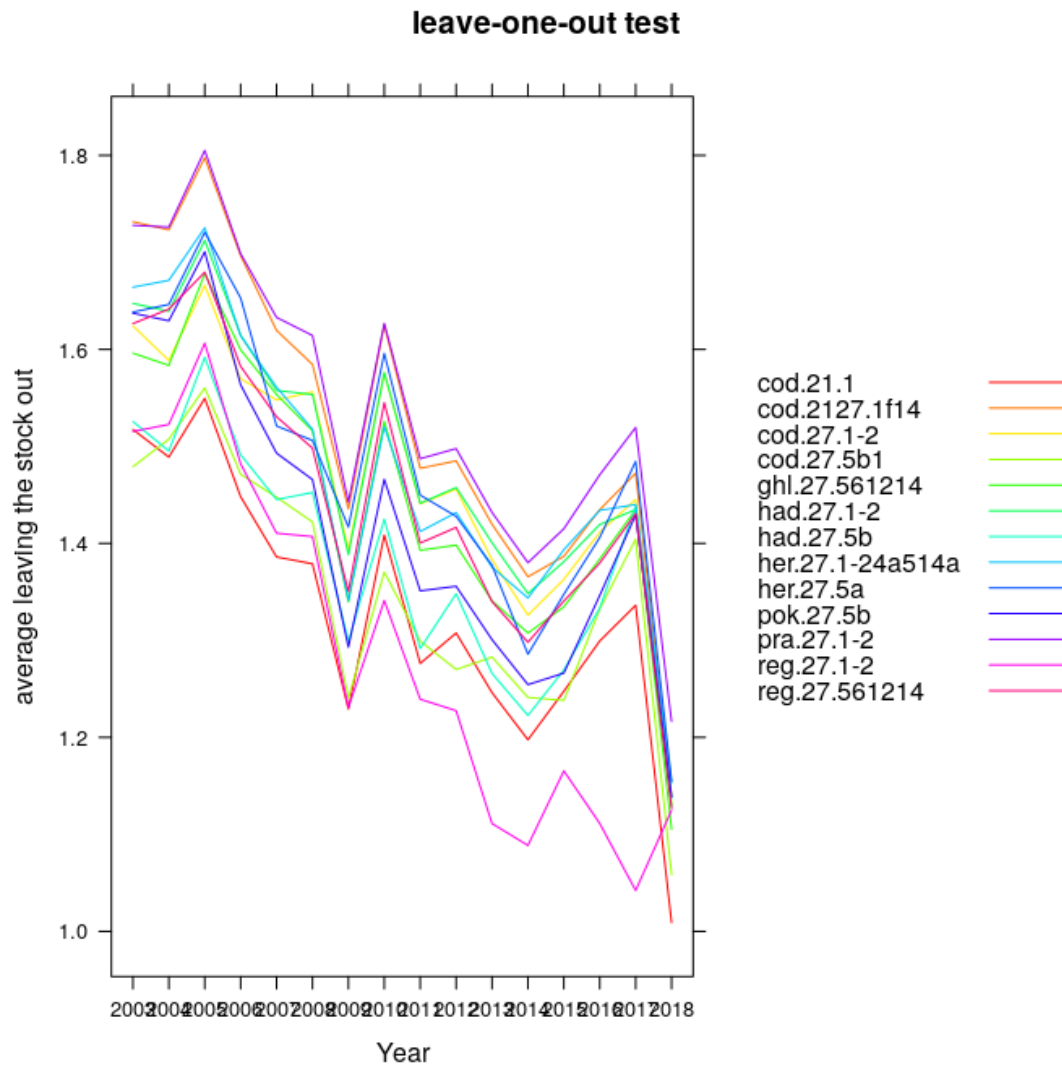


4 Individual stocks' impact on average estimates with leave-one-out algorithm

```

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