

```

1 #####
2 # ANNEX IV - MSE CODE
3 #####
4
5
6 #####
7 # EJ(20150610-20150703) JRC, IPSC, MAU <ernesto.jardim@jrc.ec.europa.eu>
8 # MSE to test the options given by MARE to EWG1509 - NWMed MAP
9 # Based on FLR (http://flr-project.org)
10 # and a4a (https://fishreg.jrc.ec.europa.eu/web/a4a)
11 #####
12 # IMPORTANT
13 # This code is made available under a creative commons license BY-SA 4.0
14 # (http://creativecommons.org/licenses/by-sa/4.0/)
15 #####
16
17 #=====
18 # NOTE: The first intermediate year must be the last on the assessment so that
19 # the OM has information for the MPs assessment/intermediate year.
20 #=====
21
22 #=====
23 # libraries and constants
24 #=====
25 library(FLa4a)
26 library(FLash)
27 library(FLBRP)
28 library(FLAssess)
29 library(FLXSA)
30 library(ggplotFL)
31 source("funs.R")
32
33 #=====
34 # Read data
35 #=====
36
37 load("../..data/HKESA07.RData")
38 attach("../..data/HKESA07_idx.RData")
39 idx <- hke.idx[[1]]
40 detach()
41
42 #=====
43 # Setup
44 #=====
45
46 # stock
47 range(stk)[c("minfbar", "maxfbar")] <- c(0,1)
48 catch.n(stk) <- landings.n(stk)
49
50 # fixed variables
51 it <- 250
52 amx <- range(stk)["max"]
53 y0 <- range(stk)["minyear"] # initial data year
54 # data year, assessment year and initial projections year (also intermediate)
55 dy <- ay <- iy <- range(stk)["maxyear"]
56 ny <- 24 # number of years to project
57 fy <- iy + ny - 1 # final year
58 vy <- ac(iy:fy) # year vector for projections
59 nsqy <- 3 # number of years to compute status quo metrics
60 trgy <- 2015
61
62 #=====
63 # Conditioning
64 #=====
65
66 catch.n(stk)[catch.n(stk)==0] <- 0.01
67 index(idx)[index(idx)==0] <- 0.01
68 fit <- sca(stk, FLIndices(idx), fit="assessment", fmodel=~s(age, k=5) + s(year, k=10))
69 stk <- stk + fit
70 sstk <- stk + simulate(fit, it)

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71 pstk <- stf(sstk, ny, 5, 5)
72 landings.n(pstk) <- propagate(landings.n(pstk), it)
73 discards.n(pstk) <- propagate(discards.n(pstk), it)
74
75 #-----
76 # S/R
77 #-----
78 sr <- fmle(as.FLSR(stk, model="geomean")) # bevholt, ricker
79
80 #-----
81 # BRP
82 #-----
83 rp <- brp(FLBRP(stk, sr))
84
85 #-----
86 # S/R residuals
87 #-----
88 sr.res <- window(rec(pstk), iy, fy)
89 sr.res[] <- sample(c(residuals(sr)), ny*it, replace=TRUE)
90
91 #-----
92 # index (pulled to 1st of January)
93 #-----
94 lst <- mcf(list(idx@index, stock.n(stk)))
95 idx.lq <- log(lst[[1]]/lst[[2]])
96 idx.lq[is.infinite(idx.lq)] <- NA # fix zeros
97 idx.qmu <- idx.qsig <- stock.n(iter(pstk,1))
98 idx.qmu[] <- yearMeans(idx.lq)
99 idx.qsig[] <- log((sqrt(yearVars(idx.lq))/yearMeans(idx.lq))^2 + 1)
100 idx.q <- idx <- FLQuant(NA, dimnames=dimnames(stock.n(pstk)))
101 idx.q[,ac(y0:dy)] <- propagate(exp(idx.lq[,ac(y0:dy)]), it)
102 idx.q[!is.na(idx.qmu)] <- rlnorm(it, idx.qmu[!is.na(idx.qmu)], idx.qsig[!is.na(idx.qmu)])
103 plot(idx.q)
104 idx <- idx.q * stock.n(pstk)
105 idx <- FLIndex(index=idx, index.q=idx.q)
106 range(idx)[c("startf", "endf")] <- c(0, 0)
107 plot(index(idx))
108
109 #=====
110 # Management scenarios
111 #=====
112 #fmsy <- refpts(rp)["msy","harvest"]
113 #fmsy <- refpts(rp)["f0.1","harvest"]
114 fmsy <- 0.20
115 blim <- min(ssb(stk))
116 bpa <- blim*1.4
117 fupp <- 0.007801555 + 1.349401721*fmsy
118 flow <- 0.00296635 + 0.66021447*fmsy
119
120 #=====
121 # Projections
122 #=====
123
124 ftrg <- mean(fbar(stk)[,ac(2011:2013)])
125 #ftrg <- mean(fbar(stk))
126 perfstats <- harvest(pstk)
127 perfstats[] <- NA
128 dt <- date()
129 sa <- list()
130
131 # go fish
132 for(i in vy[-length(vy)]){
133   gc()
134   ay <- an(i)
135   cat(i, " > ")
136   vy0 <- 1:(ay-y0) # data years (positions vector)
137   sqy <- (ay-y0-nsqy+1):(ay-y0) # status quo years (positions vector)
138   stk0 <- pstk[,vy0]
139   # change M before assessing
140   catch.n(stk0) <- catch.n(stk0) + 1 # avoid zeros

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141     idx0 <- idx[,vy0]
142     index(idx)[,i] <- stock.n(pstk)[,i]*index.q(idx)[,i]
143     fit0 <- sca(stk0, FLIndices(idx0), fmodel=~factor(age) + factor(year))
144     stk0 <- stk0 + fit0
145     # fwd control
146     fsq0 <- yearMeans(fbar(stk0)[,sqy])
147     dnms <- list(iter=1:it, year=c(ay, ay+1), c("min", "val", "max"))
148     arr0 <- array(NA, dimnames=dnms, dim=unlist(lapply(dnms, length)))
149     ftrg0 <- fsq0 - (fsq0-ftrg)/ifelse(trgy - ay < 1, 1, trgy - ay)
150     arr0[,,"val"] <- c(fsq0, ftrg0)
151     arr0 <- aperm(arr0, c(2,3,1))
152     ctrl <- fwdControl(data.frame(year=c(ay,ay+1), quantity="f", val=NA))
153     ctrl@trgtArray <- arr0
154     #stkTmp <- stf(stk0, 3)
155     #stkTmp <- fwd(stkTmp, ctrl=ctrl, sr=sr, sr.residuals = exp(sr.res[,ac(ay:(ay+1))]),
sr.residuals.mult = TRUE)

156
157     # OM proj
158     ctrl@target <- ctrl@target[2,]
159     ctrl@trgtArray <- ctrl@trgtArray[2,,drop=FALSE]
160     ctrl@target["rel.year"] <- ay-1
161     perfstats[1,ac(ay-1)] <- fbar(pstk)[,ac(ay-1)]
162     perfstats[2,ac(ay-1)] <- fbar(stk0)[,ac(ay-1)]
163     perfstats[3,ac(ay-1)] <- fsq0
164     perfstats[4,ac(ay+1)] <- ftrg0
165     # until 2015 keep fsq
166     if(ay<2015) ctrl@trgtArray[, "val",] <- 1 else ctrl@trgtArray[, "val",] <- c(ftrg0)/c
(fsq0)

167
168     pstk <- fwd(pstk, ctrl=ctrl, sr=sr, sr.residuals = exp(sr.res[,ac(ay+1)]),
sr.residuals.mult = TRUE)
169 }
170
171 hke07.opt1 <- pstk
172 save(hke07.opt1, perfstats, file="hke070pt1.RData")
173
174 #=====
175 # Projections
176 #=====
177
178 ftrg <- fmsy
179 perfstats <- harvest(pstk)
180 perfstats[] <- NA
181 dt <- date()
182 sa <- list()
183 trgy <- 2018
184
185 # go fish
186 for(i in vy[-length(vy)]){
187     gc()
188     ay <- an(i)
189     cat(i, " > ")
190     vy0 <- 1:(ay-y0) # data years (positions vector)
191     sqy <- (ay-y0-nsqy+1):(ay-y0) # status quo years (positions vector)
192     stk0 <- pstk[,vy0]
193     # change M before assessing
194     catch.n(stk0) <- catch.n(stk0) + 1 # avoid zeros
195     idx0 <- idx[,vy0]
196     index(idx)[,i] <- stock.n(pstk)[,i]*index.q(idx)[,i]
197     fit0 <- sca(stk0, FLIndices(idx0), fmodel=~factor(age) + factor(year))
198     stk0 <- stk0 + fit0
199     # fwd control
200     fsq0 <- yearMeans(fbar(stk0)[,sqy])
201     dnms <- list(iter=1:it, year=c(ay, ay+1), c("min", "val", "max"))
202     arr0 <- array(NA, dimnames=dnms, dim=unlist(lapply(dnms, length)))
203     ftrg0 <- fsq0 - (fsq0-ftrg)/ifelse(trgy - ay < 1, 1, trgy - ay)
204     arr0[,,"val"] <- c(fsq0, ftrg0)
205     arr0 <- aperm(arr0, c(2,3,1))
206     ctrl <- fwdControl(data.frame(year=c(ay,ay+1), quantity="f", val=NA))
207     ctrl@trgtArray <- arr0

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```

208     #stkTmp <- stf(stk0, 3)
209     #stkTmp <- fwd(stkTmp, ctrl=ctrl, sr=sr, sr.residuals = exp(sr.res[,ac(ay:(ay+1))]),
sr.residuals.mult = TRUE)

210
211     # OM proj
212     ctrl@target <- ctrl@target[2,]
213     ctrl@trgtArray <- ctrl@trgtArray[2,,,drop=FALSE]
214     ctrl@target["rel.year"] <- ay-1
215     perfstats[1,ac(ay-1)] <- fbar(pstk)[,ac(ay-1)]
216     perfstats[2,ac(ay-1)] <- fbar(stk0)[,ac(ay-1)]
217     perfstats[3,ac(ay-1)] <- fsq0
218     perfstats[4,ac(ay+1)] <- ftrg0
219     # until 2015 keep fsq
220     if(ay<2015) ctrl@trgtArray[, "val",] <- 1 else ctrl@trgtArray[, "val",] <- c(ftrg0)/c
(fsq0)

221
222     pstk <- fwd(pstk, ctrl=ctrl, sr=sr, sr.residuals = exp(sr.res[,ac(ay+1)]),
sr.residuals.mult = TRUE)
223 }
224
225 hke07.opt2.2018 <- pstk
226 save(hke07.opt2.2018, perfstats, file="hke070pt22018.RData")
227
228 #=====
229 # Projections
230 #=====
231
232 ftrg <- fmsy
233 perfstats <- harvest(pstk)
234 perfstats[] <- NA
235 trgy <- 2020
236
237 # go fish
238 for(i in vy[-length(vy)]){
239     gc()
240     ay <- an(i)
241     cat(i, " > ")
242     vy0 <- 1:(ay-y0) # data years (positions vector)
243     sqy <- (ay-y0-nsqy+1):(ay-y0) # status quo years (positions vector)
244     stk0 <- pstk[,vy0]
245     # change M before assessing
246     catch.n(stk0) <- catch.n(stk0) + 1 # avoid zeros
247     idx0 <- idx[,vy0]
248     index(idx)[,i] <- stock.n(pstk)[,i]*index.q(idx)[,i]
249     fit0 <- sca(stk0, FLIndices(idx0), fmodel=~factor(age) + factor(year))
250     stk0 <- stk0 + fit0
251     # fwd control
252     fsq0 <- yearMeans(fbar(stk0)[,sqy])
253     dnms <- list(iter=1:it, year=c(ay, ay+1), c("min", "val", "max"))
254     arr0 <- array(NA, dimnames=dnms, dim=unlist(lapply(dnms, length)))
255     ftrg0 <- fsq0 - (fsq0-ftrg)/ifelse(trgy - ay < 1, 1, trgy - ay)
256     arr0[,,"val"] <- c(fsq0, ftrg0)
257     arr0 <- aperm(arr0, c(2,3,1))
258     ctrl <- fwdControl(data.frame(year=c(ay,ay+1), quantity="f", val=NA))
259     ctrl@trgtArray <- arr0
260     #stkTmp <- stf(stk0, 3)
261     #stkTmp <- fwd(stkTmp, ctrl=ctrl, sr=sr, sr.residuals = exp(sr.res[,ac(ay:(ay+1))]),
sr.residuals.mult = TRUE)

262
263     # OM proj
264     ctrl@target <- ctrl@target[2,]
265     ctrl@trgtArray <- ctrl@trgtArray[2,,,drop=FALSE]
266     ctrl@target["rel.year"] <- ay-1
267     perfstats[1,ac(ay-1)] <- fbar(pstk)[,ac(ay-1)]
268     perfstats[2,ac(ay-1)] <- fbar(stk0)[,ac(ay-1)]
269     perfstats[3,ac(ay-1)] <- fsq0
270     perfstats[4,ac(ay+1)] <- ftrg0
271     # until 2015 keep fsq
272     if(ay<2015) ctrl@trgtArray[, "val",] <- 1 else ctrl@trgtArray[, "val",] <- c(ftrg0)/c
(fsq0)

```

```

273     pstk <- fwd(pstk, ctrl=ctrl, sr=sr, sr.residuals = exp(sr.res[,ac(ay+1)]),
274 sr.residuals.mult = TRUE)
275 }
276
277 hke07.opt2.2020 <- pstk
278 save(hke07.opt2.2020, perfstats, file="hke070pt22020.RData")
279
280 #=====
281 # Projections
282 #=====
283
284 ftrg <- flow
285 perfstats <- harvest(pstk)
286 perfstats[] <- NA
287 dt <- date()
288 sa <- list()
289
290 # go fish
291 for(i in vy[-length(vy)]){
292   gc()
293   ay <- an(i)
294   cat(i, " > ")
295   vy0 <- 1:(ay-y0) # data years (positions vector)
296   sqy <- (ay-y0-nsqy+1):(ay-y0) # status quo years (positions vector)
297   stk0 <- pstk[,vy0]
298   # change M before assessing
299   catch.n(stk0) <- catch.n(stk0) + 1 # avoid zeros
300   idx0 <- idx[,vy0]
301   index(idx)[,i] <- stock.n(pstk)[,i]*index.q(idx)[,i]
302   fit0 <- sca(stk0, FLIndices(idx0), fmodel=~factor(age) + factor(year))
303   stk0 <- stk0 + fit0
304   # fwd control
305   fsq0 <- yearMeans(fbar(stk0)[,sqy])
306   dnms <- list(iter=1:it, year=c(ay, ay+1, ay+1), c("min", "val", "max"))
307   arr0 <- array(NA, dimnames=dnms, dim=unlist(lapply(dnms, length)))
308   ftrg0 <- fsq0 - (fsq0-ftrg)/ifelse(trgy - ay < 1, 1, trgy - ay)
309   arr0[,,"val"] <- c(fsq0, ftrg0, rep(NA, it))
310   arr0[,,"min"] <- c(rep(NA, it), rep(NA, it), rep(bpa, it))
311   arr0 <- aperm(arr0, c(2,3,1))
312   ctrl <- fwdControl(data.frame(year=c(ay, ay+1, ay+1), quantity=c("f", "f", "ssb"),
val=NA))
313   ctrl@trgtArray <- arr0
314   stkTmp <- stf(stk0, 3)
315   stkTmp <- fwd(stkTmp, ctrl=ctrl, sr=sr, sr.residuals = exp(sr.res[,ac(ay:(ay+1)])),
sr.residuals.mult = TRUE)
316
317   # OM proj
318   ctrl@target <- ctrl@target[2,]
319   ctrl@trgtArray <- ctrl@trgtArray[2,,drop=FALSE]
320   ctrl@target["rel.year"] <- ay-1
321   perfstats[1,ac(ay-1)] <- fbar(pstk)[,ac(ay-1)]
322   perfstats[2,ac(ay-1)] <- fbar(stk0)[,ac(ay-1)]
323   perfstats[3,ac(ay-1)] <- fsq0
324   perfstats[4,ac(ay+1)] <- ftrg0
325   # until 2015 keep fsq
326   if(ay<2015) ctrl@trgtArray[, "val",] <- 1 else ctrl@trgtArray[, "val",] <- c(fbar
(stkTmp)[,ac(ay+1)]/c(fsq0)
327
328   pstk <- fwd(pstk, ctrl=ctrl, sr=sr, sr.residuals = exp(sr.res[,ac(ay+1)]),
sr.residuals.mult = TRUE)
329 }
330
331 hke07.opt3lo <- pstk
332 save(hke07.opt3lo, file="hke070pt3lo.RData")
333
334 #=====
335 # Projections
336 #=====
337

```

```

338 ftrg <- fupp
339 perfstats <- harvest(pstk)
340 perfstats[] <- NA
341 dt <- date()
342 sa <- list()
343
344 # go fish
345 for(i in vy[-length(vy)]){
346   gc()
347   ay <- an(i)
348   cat(i, " > ")
349   vy0 <- 1:(ay-y0) # data years (positions vector)
350   sqy <- (ay-y0-nsqy+1):(ay-y0) # status quo years (positions vector)
351   stk0 <- pstk[,vy0]
352   # change M before assessing
353   catch.n(stk0) <- catch.n(stk0) + 1 # avoid zeros
354   idx0 <- idx[,vy0]
355   index(idx)[,i] <- stock.n(pstk)[,i]*index.q(idx)[,i]
356   fit0 <- sca(stk0, FLIndices(idx0), fmodel=~factor(age) + factor(year))
357   stk0 <- stk0 + fit0
358   # fwd control
359   fsq0 <- yearMeans(fbar(stk0)[,sqy])
360   dnms <- list(iter=1:it, year=c(ay, ay+1, ay+1), c("min", "val", "max"))
361   arr0 <- array(NA, dimnames=dnms, dim=unlist(lapply(dnms, length)))
362   ftrg0 <- fsq0 - (fsq0-ftrg)/ifelse(trgy - ay < 1, 1, trgy - ay)
363   arr0[,,"val"] <- c(fsq0, ftrg0, rep(NA, it))
364   arr0[,,"min"] <- c(rep(NA, it), rep(NA, it), rep(bpa, it))
365   arr0 <- aperm(arr0, c(2,3,1))
366   ctrl <- fwdControl(data.frame(year=c(ay, ay+1, ay+1), quantity=c("f", "f", "ssb"),
val=NA))
367   ctrl@trgtArray <- arr0
368   stkTmp <- stf(stk0, 3)
369   stkTmp <- fwd(stkTmp, ctrl=ctrl, sr=sr, sr.residuals = exp(sr.res[,ac(ay:(ay+1))]),
sr.residuals.mult = TRUE)
370
371   # OM proj
372   ctrl@target <- ctrl@target[2,]
373   ctrl@trgtArray <- ctrl@trgtArray[2,,,drop=FALSE]
374   ctrl@target["rel.year"] <- ay-1
375   perfstats[1,ac(ay-1)] <- fbar(pstk)[,ac(ay-1)]
376   perfstats[2,ac(ay-1)] <- fbar(stk0)[,ac(ay-1)]
377   perfstats[3,ac(ay-1)] <- fsq0
378   perfstats[4,ac(ay+1)] <- ftrg0
379   # until 2015 keep fsq
380   if(ay<2015) ctrl@trgtArray[, "val",] <- 1 else ctrl@trgtArray[, "val",] <- c(fbar
(stkTmp)[,ac(ay+1)])/c(fsq0)
381
382   pstk <- fwd(pstk, ctrl=ctrl, sr=sr, sr.residuals = exp(sr.res[,ac(ay+1)]),
sr.residuals.mult = TRUE)
383 }
384
385 hke07.opt3up <- pstk
386 save(hke07.opt3up, file="hke070pt3up.RData")
387
388 q("yes")
389

```