Vignette for the Bayesian Surplus Production Model with Catch-Reslience Method C_{msy}

Part I - Model Execution

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Part I - End-user model execution

The end-user will specify and execute the simulation using the following commands. The user will necessarily source() the full BSPSP model, which is detailed in Part II.

The user specifies which of four model types to implement, amongst:

- 1. Schaefer
- 2. Schaefer with Depensation (CMSY: Froese et al. 2016)
- 3. Fox
- 4. Fox with Depensation (CMSY: Froese et al. 2016)

```
# Choose Scenario name for creating a seperate folder
# S1: Base-Case
Scenarios = c("Base-Case")
for(s in 1:1){
Scenario = Scenarios[s]
# Choose model type:
# 1: Schaefer
# 2: Schaefer with Depensation (CMSY: Froese et al. 2016)
# 4: Fox with Depensation (CMSY: Froese et al. 2016)
 Model = 1 # model
 Mod.names = c("Schaefer", "Schaefer.RecImp", "Fox", "Fox.RecImp", "Pella") [Model]
  # Set shape (> 0, with 1.001 ~ Fox and 2 = Schaefer)
  shape = FALSE # set to False for using Models 1-4
  setwd(paste(File))
  # Load assessment data
  # cpue = read.csv(paste0(assessment, "/cpue", assessment, ".csv"))#
  # se = read.csv(pasteO(assessment, "/se", assessment, ".csv"))# use 0.001 if not available
  # catch = read.csv(pasteO(assessment, "/catch", assessment, ".csv"))
  cpue = read.csv(paste0(File, "/cpue", assessment, ".csv"))#
```

```
se = read.csv(paste0(File, "/se", assessment, ".csv"))# use 0.001 if not available
catch = read.csv(paste0(File,"/catch",assessment,".csv"))
names(cpue)
names(catch)
# option to exclude CPUE time series or catch year
# mean and CV and sd for unfished biomass K (SBO)
mu.K = 200000; CV.K = 2; sd.K=sqrt(log(CV.K^2+1))
K.pr = c(mu.K,sd.K)
# mean and CV and sd for Initial depletion level P1= SB/SB0
# To be translated into Beta prior as psi.pr
mu.psi = 0.95; CV.psi = 0.05; sd.psi = sqrt(log(CV.psi^2+1)) # choose 0.99 and 0.001 for SB1
# Determine estimation for catchability q and observation error
# Assign q to CPUE
sets.q = 1:(ncol(cpue)-1)
# Series
\#sets.var = rep(1,ncol(cpue)-1)\# estimate the same additional variance error
sets.var = 1:(ncol(cpue)-1) # estimate individual additional variace
# As option for data-weighing
# minimum additional observation error for each variance set (optional choose 1 value for bo
min.obsE = c(0.1) # Important if SE.I is not availble
# Use SEs for abudance indices (TRUE/FALSE)
SE.I = TRUE
```

Assignment of model priors

Because prior formulations for most SPM-based assessments are specified for r, we provide the following equation to easily convert r estimates (or prior means) into HMSY for any given shape parameter input m:

$$H_{MSY} = r \frac{m-1}{1 - m^{-1}}$$

However, if the prior for r is derived based on Leslie matrix approach, as commonly used for a logistic

Schaefer model, we recommend approximating HMSY = r / 2 for the purpose of comparability among Schaefer, Fox and Pella-Tomlinson production function.

Equations (5) - (10) in the reference paper illustrate the direct link between the Pella-Tomlinson SPM and the age-structured, which emphasizes the potential for deriving informative priors for r and m from spawning biomass- and yield-per-recruit analysis with integrated spawning recruitment relationships by generating deviates of $H_{MSY} = MSY/B_{MSY}$ and B_{MSY}/K , respectively (Maunder 2003, Thorson et al. 2012b, Wang et al. 2014).

```
# Prior specification for Models 1-4, i.e. Schaefer, Fox
# Determine r prior
## The options are:
# a) Specifying a lognormal prior
# b) Specifying a resiliance category after Froese et al. (2016; CMSY)
# Resilience: "Very low", "Low", "Medium", High"
\#r.prior = "Low"
r.prior = c(0.01,0.06) # as range with upper and lower bound of lnorm prior
# Execute model and produce output
# set TRUE if PUCL rules should be applied
pucl = FALSE
# Option to produce standard KOBE plot
KOBE.plot = TRUE
# Process Error
#Estimate set sigma.proc == True
# IF Fixed: typicallly 0.05-0.15 (see Ono et al. 2012)
sigma.proc = TRUE
# sigma.proc = 0.07 # Example for fixing the Process error
# MCMC settings
ni <- 50000 # Number of iterations
nt <- 10 # Steps saved
nb <- 10000 # Burn-in
nc <- 2 # number of chains
# Run model (BSPSPexe file must be in the same working directory)
source(paste0(File,"/BSPSP_ICCATv3.r"))
}# THE END
```