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 necessarliy `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)
# 3: Fox
# 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(paste0(assessment,"/se",assessment,".csv"))# use 0.001 if not available
  # catch = read.csv(paste0(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 (SB0)

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
```