

## Appendix S2

Example of state-space model code in R language.

```
library(R2jags)

sink("ssm.jags")
ssm.jags
cat("
model {
logN.est[1] ~ dnorm(y[1], 0.01)
mean.r ~ dnorm(1, 0.001)
sigma.proc ~ dunif(0, 1)
sigma2.proc <- pow(sigma.proc, 2)
tau.proc <- pow(sigma.proc, -2)
sigma.obs ~ dunif(0, 1)      # Prior for the sd of observation process
sigma2.obs <- pow(sigma.obs, 2)
tau.obs <- pow(sigma.obs, -2)
for (t in 1:(T-1)){
  r[t] ~ dnorm(mean.r, tau.proc)
  logN.est[t+1] <- logN.est[t] + r[t]
}
for (t in 2:T) {
  y[t] ~ dnorm(logN.est[t], tau.obs)
}
for (t in 1:T) {
  N.est[t] <- exp(logN.est[t])
}
}
",fill = TRUE)
sink()
jags.data <- list(y = log(y), T = nmonths)
inits <- function(){list(sigma.proc = runif(1, 0, 1), mean.r = rnorm(1), sigma.obs =
runif(1, 0, 1), logN.est = c(rnorm(1, 5.6, 0.1), rep(NA, nmonths-1)))}
parameters <- c("r", "mean.r", "sigma2.obs", "sigma2.proc", "N.est")
ni <- 200000
nt <- 6
nb <- 100000
nc <- 3
cpue.ssm <- jags(jags.data, inits, parameters, "ssm.jags", n.chains = nc, n.thin = nt,
n.iter = ni, n.burnin = nb, working.directory = getwd())
print(cpue.ssm, digits = 3)
```