

*Supplementary Information*

Spatial mark-resight models to estimate feral pig population density.

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**Supplemental S2**

**Spatial Mark-Resight code (modified from Royle et al., 2014) in Nimble (NIMBLE Development Team, 2015).**

```
code <- nimbleCode({

# Prior
psi ~ dunif(0,1)
lam0 ~ dunif(0,5)
sigma ~ dunif(0,5)

# Recognizable part
for(i in 1:max) {
  srec[i,1] ~ dunif(xlim[1],xlim[2])
  srec[i,2] ~ dunif(ylim[1],ylim[2])
  distmid[i,1:J] <- (srec[i,1] - X[1:J,1])^2 + (srec[i,2] - X[1:J,2])^2
  lambdamid[i,1:J]<-lam0*exp(-distmid[i,1:J]/(2*sigma^2))

  for(j in 1:J) {
    yrec[i,j]~ dpois(lambdamid[i,j]*K)
  }
}

# Unmarked part
for(i in 1:M) {
  z[i] ~ dbern(psi)
  s[i,1] ~ dunif(xlim[1], xlim[2])
  s[i,2] ~ dunif(ylim[1], ylim[2])
  dist[i,1:J] <- (s[i,1] - X[1:J,1])^2 + (s[i,2] - X[1:J,2])^2
  lam[i,1:J] <- lam0*exp(-dist[i,1:J]/(2*sigma^2))*z[i]*K
}

for(j in 1:J){
  bigLambda[j] <- sum(lam[1:M,j])
  n[j,k] ~ dpois(bigLambda[j])
}

Nu <- sum(z[1:M])
N <- Nu + max
D <- N/área

})
```

**SCR- Transience code (modified from Royle et al., 2016) in Nimble (NIMBLE Development Team, 2015)**

```
library(nimble)
code <- nimbleCode({

  p0 ~ dunif(0,1)
  sigma.scr ~ dunif(0,10)
  alpha1<- 1/(2*sigma.scr*sigma.scr)
  psi~dunif(0,1)
  sigma.rw ~ dunif(0,5)
  tau<- 1/(sigma.rw*sigma.rw)

  for(i in 1:M){
    z[i] ~ dbern(psi)
    s[i,1,1]~dunif(xlim[1],xlim[2])
    s[i,2,1]~dunif(ylim[1],ylim[2])
    d[i,1:J,1] <- pow(s[i,1,1]-X[1:J,1],2) + pow(s[i,2,1]-X[1:J,2],2)
    p[i,1:J,1] <- z[i]*p0*exp(- alpha1*d[i,1:J,1])

    for(j in 1:J){
      Yarr[i,j,1] ~ dbin(p[i,j,1],1)
    }

    for(k in 2:K){
      s[i,1,k]~T(dnorm(s[i,1,k-1],tau), xlim[1], xlim[2])
      s[i,2,k]~T(dnorm(s[i,2,k-1],tau), ylim[1], ylim[2])
      d[i,1:J,k]<- pow(s[i,1,k]-X[1:J,1],2) + pow(s[i,2,k]-X[1:J,2],2)
      p[i,1:J,k]<- z[i]*p0*exp(- alpha1*d[i,1:J,k])

      for(j in 1:J){
        Yarr[i,j,k] ~ dbin(p[i,j,k],1)
      }
    }
  }
  N<-sum(z[1:M])
  D<- N/area
})
```

**References**

- NIMBLE Development Team, 2015. NIMBLE: An R Package for Programming with BUGS models.
- Royle J.A., Chandler R.B., Sollmann R., Gardner B., 2014. Spatial capture-recapture. Waltham, Massachusetts: Elsevier, Academic Press.
- Royle J.A., Fuller A.K., Sutherland C., 2016. Spatial capture-recapture models allowing Markovian transience or dispersal. *Popul. Ecol.* 58: 53–62.