**S1 Text**

**Bayesian Models defined for use in R and JAGS**

Models defined in the paper are described here in language appropriate for use in the JAGS tool. Code for reproducing analysis is publicly available from Github: https://github.com/DVMath/MosqCapRecap

**Model M0**

model {

for (t in 1:totT) {

X[t] <- p

Xu[t] <- p

}

theta <- sum(X[])

thetau <- sum(Xu[])

Ncapt ~ dpois(theta \* N)

Ucapt ~ dpois(thetau \* U)

Yu ~ dmulti(Xu, Ucapt)

Y ~ dmulti(X, Ncapt)

U ~ dpois(v)

v ~ dgamma(0.01, 0.01)

p ~ dbeta(2,4)

}

**Model MS**

model {

for (t in 1:totT) {

X[t] <- pow(phi,t)\*p

Yu[t] ~ dbin(p, U)

}

theta <- sum(X[])

Ncapt ~ dpois(theta\* N)

Y ~ dmulti(X, Ncapt)

U ~ dpois(v)

v ~ dgamma(0.01, 0.01)

phi ~ dbeta(4,2)

p ~ dbeta(2,4)

}

**Model MB**

model {

for (t in 1:totT) {

 X[t] <- pow(phi,t)\*pow(1-p, t-1)\*p

}

Xu[1] <- 1

for (t in 2:totT) {

 Xu[t] <- 1-p\*Xu[t-1]

}

theta <- sum(X[])

thetau <- sum(Xu[])

Ncapt ~ dpois(theta\* N)

for (i in 1:totT) {

 Ut[i] ~ dpois(U\*Xu[i])

}

Y ~ dmulti(X, Ncapt)

for (i in 1:totT) {

 Yu[i] ~ dbin(p, Ut[i])

}

#priors

Nu ~ dgamma(0.001, 0.001)

p ~ dbeta(2,2)

phi ~ dbeta(4,2)

U <- Nu

}

**Model MRSU**

model {

for (t in 1:totT) {

 X[t] <- pow(phi,t)\*pow(1-p, t-1)\*p

# for unmarked p is counted below

 Xu[t] <- pow(phi,t)\*pow(1-p, t-1)

}

Ru[1] <- phi

for (t in 2:totT) {

 Ru[t] <- Ru[t-1] + pow(phi,t)\*pow(1-p,t-1)

}

theta <- sum(X[])

thetau <- sum(Xu[])

Ncapt ~ dpois(theta\* N)

for (i in 1:totT) {

 Ut[i] ~ dpois(Nu\*Xu[i])

}

Y ~ dmulti(X, Ncapt)

for (i in 1:totT) {

 bt[i] ~ dpois(l\*Ru[i])

}

for (i in 1:totT) {

 Yu[i] ~ dbin(p, Ut[i]+bt[i])

}

#priors

Nu ~ dgamma(0.01, 0.01)

p ~ dbeta(2,2)

phi ~ dbeta(4,2)

#probability of not being observed

l ~ dlnorm(10, 1/4.0)

U <- Nu+l

}

**Model MRP**

model {

for (t in 1:totT) {

 X[t] <- pow(phi,t)\*pow(1-p, t-1)\*p

# for unmarked p is counted below

 Xu[t] <- pow(phiu,t)\*pow(1-p, t-1)

}

Ru[1] <- phiu

for (t in 2:totT) {

 Ru[t] <- Ru[t-1] + pow(phiu,t)\*pow(1-p,t-1)

}

theta <- sum(X[])

thetau <- sum(Xu[])

Ncapt ~ dpois(theta\* N)

for (i in 1:totT) {

 Ut[i] ~ dpois(Nu\*Xu[i])

}

Y ~ dmulti(X, Ncapt)

for (i in 1:totT) {

 bt[i] ~ dpois(l\*Ru[i])

}

for (i in 1:totT) {

 Yu[i] ~ dbin(p, Ut[i]+bt[i])

}

#priors

Nu ~ dgamma(0.001, 0.001)

p ~ dbeta(2,2)

phi ~ dbeta(4,2)

phiu ~ dbeta(2,2)

totpup ~ dbin(1-phiu, round(4\*U\*fa))

#probability of not being observed

l ~ dlnorm(10, 1/4.0)

U <- Nu+l

}