Appendix A: Model Code

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1 DEPLETION MODEL WITHOUT REGRESSION

JAGS (Just Another Gibbs Sampler) model used to estimate the catchability of New Zealand abalone (pāua, *Haliotis iris*) for each individual commercial diver (as specified in Equation 4).

```
model {
  for (i in 1: N){
   # Depletion model - K is the cumulative catch
    logcatch[i] ~ dnorm(mu[i], theta)
    mu[i] <- base_effort[i] +
        log(q[diver[i]]) +
        log(B0 - K[i])

    # Predicted catch at i
    pcatch[i] ~ dnorm(mu[i], theta)
    ecatch[i] <- exp(pcatch[i])
  }

  # Random catchability by diver
  for (j in 1:DIVERS){
    logit(q[j]) <- qmean + te.xi*te.eta[j]
    te.eta[j] ~ dnorm(0, SEprec)
  }
  # Mean catchability
  qmean ~ dnorm(0, 0.001)

  # Half-Cauchy variance prior for diver effect
  te.xi ~ dnorm(0, 0.01)
  SEprec ~ dgamma(0.5, 0.5)

  theta ~ dgamma(0.01, 0.01)
  # KMAX is the total catch over the experiment
  B0 ~ dgamma(10e3*0.001, 0.001)T(KMAX,)
}
```

2 DEPLETION MODEL WITH REGRESSION

JAGS (Just Another Gibbs Sampler) model with a regression term added to assess if fishing effort (included as bottom time and dive depth, including an interaction term) predicted catches of New Zealand abalone (pāua, *Haliotis iris*) by commercial divers (as specified in Equation 5).

```
model {
  for (i in 1: N){
    # Depletion model - K is the cumulative catch
    logcatch[i] ~ dnorm(mu[i], theta)
    mu[i] <- base_effort[i] +
        betas %*% effort[i, 1:n.cov] +
        log(q[diver[i]]) + log(B0 - K[i])

    # Predicted catch at i
    pcatch[i] ~ dnorm(mu[i], theta)
    ecatch[i] <- exp(pcatch[i])
  }
   # Random catchability by diver
  for (j in 1:DIVERS){
    logit(q[j]) <- qmean + te.xi*te.eta[j]
    te.eta[j] ~ dnorm(0, SEprec)
  }
  # Mean catchability
  qmean ~ dnorm(0, 0.001)

  for (b in 1:n.cov ){
    betas[b] ~ dnorm(0, 0.001)
  }

  # Half-Cauchy variance prior for diver effect
  te.xi ~ dnorm(0, 0.01)
  SEprec ~ dgamma(0.5, 0.5)

  theta ~ dgamma(0.01, 0.01)
  # KMAX is the total catch over the experiment
  B0 ~ dgamma(10e3*0.001, 0.001)T(KMAX,)
}
```

3 CATCH-PER-UNIT-EFFORT INDEX MODEL

JAGS (Just Another Gibbs Sampler) model used to estimate a catch-per-unit-effort (CPUE) index for a fishery context in which the real depletion level is unknown, for monitoring CPUE in the New Zealand abalone (pāua, *Haliotis iris*) fishery (as specified in Equation 6).

```
model {
  for (i in 1:N){
    catch[i] ~ dnorm(mu[i], theta)
    mu[i] <- base_effort[i] +
        betas[1:n.cov] %*% effort[i, 1:n.cov] +
     q[diver[i]] +
        Ix[day[i]]

    # Predicted catch at i
    pcatch[i] ~ dnorm(mu[i], theta)
    ecatch[i] <- exp(pcatch[i])
  }
  # Random catchability
  for (j in 1:DIVERS){
    q[j] <- qmean + te.xi*te.eta[j]
    te.eta[j] ~ dnorm(0, SEprec)
  }
  # Mean catchability
  qmean ~ dnorm(0, 0.001)

  for (d in 1:DAYS){
    Ix[d] ~ dnorm(0,0.001)
  }

  for (b in 1:n.cov){
    betas[b] ~ dnorm(0, 0.001)
  }

  # Half-Cauchy for diver effect
  te.xi ~ dnorm(0, 0.01)
  SEprec ~ dgamma(0.5, 0.5)

  theta ~ dgamma(0.01, 0.01)
  # KMAX is the total catch over the experiment
  B0 ~ dgamma(10e3*0.001, 0.001)T(KMAX,)
}
```