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Una visión a la evaluación de stocks del Perico/Dorado (*Coryphaena hippurus*) a partir de la información de la pesquería en Perú

Edgar Josymar Torrejón – Magallanes⁽¹⁾

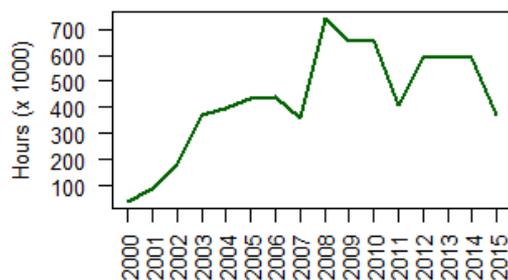
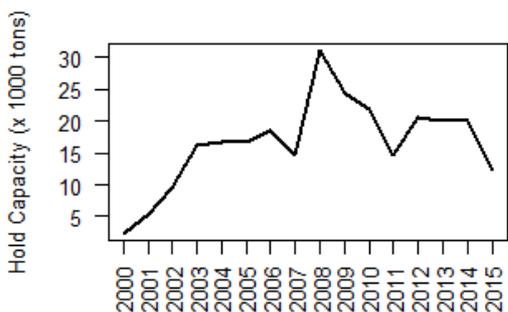
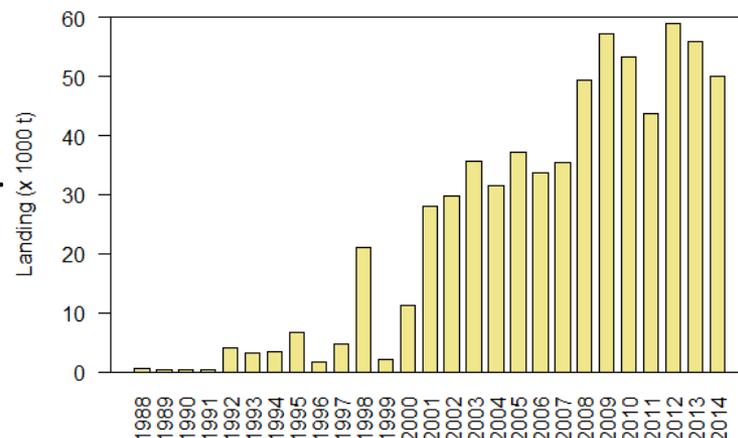
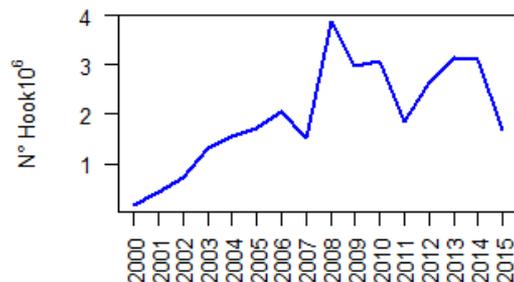
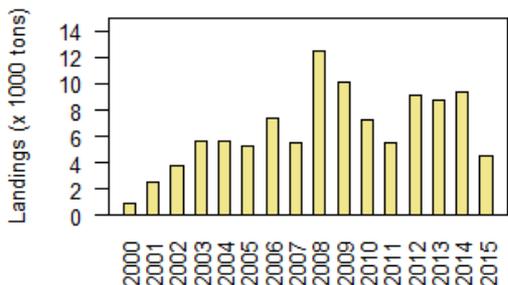
Ricardo Oliveros - Ramos

(1) Instituto del Mar del Perú (IMARPE)

2ª Reunión Técnica sobre el Dorado.
27-29 de octubre de 2015 - Lima, Perú

Data description

- **FAO - PRODUCE:**
 - Desembarques Oficiales: 1988 - 2014



- **IMARPE:**
 - Unidad de pesca artesanal.
 - Desembarques, esfuerzo.

Cuando sólo se disponen de datos de captura y esfuerzo, los modelos de biomasa dinámica son la herramienta primaria de evaluación en muchas pesquerías (Hilborn y Walters, 1992).

Parámetros Poblacionales

- A simple method for estimating MSY from catch and resilience (Martell & Froese (2012))

Inputs:

- ✓ Serie de tiempo de capturas (desembarques): FAO - PRODUCE.
- ✓ Prior de r y k (rangos) y posibles rangos del tamaño relativo del stock en el inicio y el final de la serie de tiempo de capturas.
- ✓ Clasificación de Resiliencia: FishBase (Froese *et al.* 2000).

	<i>Catch/Max Catch</i>	<i>B/K</i>
First year	<0.5	0.5 - 0.9
	≥ 0.5	0.3 - 0.6
Last year	> 0.5	0.3 - 0.7
	≤ 0.5	0.01 - 0.4

Parámetros Poblacionales

- A simple method for estimating MSY from catch and resilience (Martell & Froese, 2012)

Método:

✓ Modelo de producción de Schaefer para calcular la biomasa anual a partir del set de parámetros r y k .

$$B_{(t+1)} = B_t + r * B_t * \left(1 - \frac{B_t}{k}\right) - C_t$$

✓ Pares r - k : a partir de una distribución uniforme. (geometric means).

$$p(\log(r)) \sim \text{uniform}(\log(r_l), \log(r_u))$$

$$p(\log(k)) \sim \text{uniform}(\log(k_l), \log(k_u))$$

✓ MSY es calculado a partir de los valores de r y k

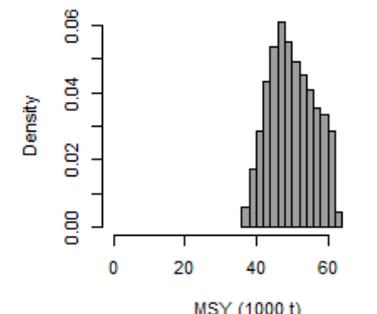
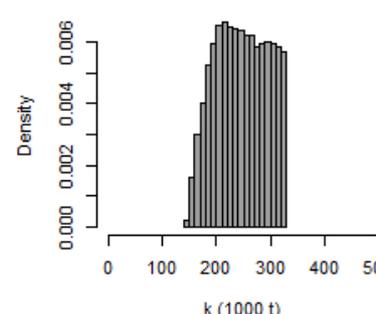
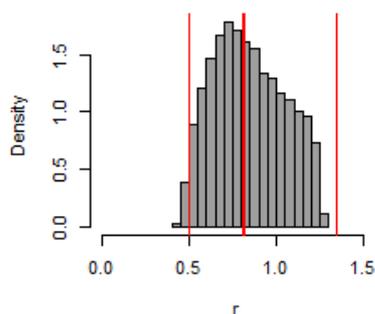
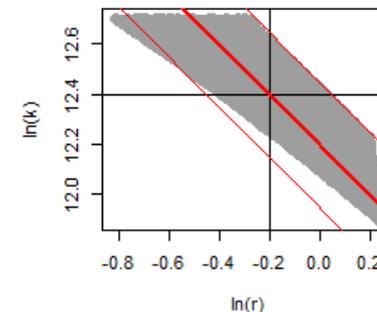
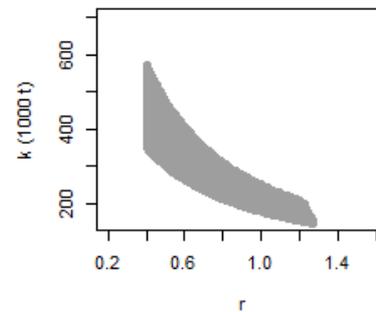
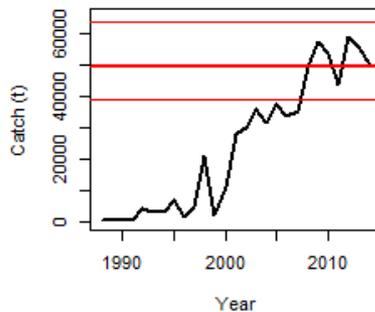
Resilience	High	Medium	Low	Very Low
$r(\text{year}^{-1})$	0.6-1.5	0.2 - 1	0.05 - 0.5	0.015 - 0.1

Tomado de: Martell & Froese (2012)

Parámetros poblacionales

- A simple method for estimating MSY from catch and resilience (Martell & Froese, 2012)

Parameters	geom. Mean	± 2 SD
$r(\text{year}^{-1})$	0.819	0.5 - 1.34
k (t)	241 973	162 484 - 360 349
B_{MSY} (t)	120 986	81 242 - 180 175
MSY (t)	49 563	38 590 - 63 656



Índice de abundancia

Estandarización de la CPUE

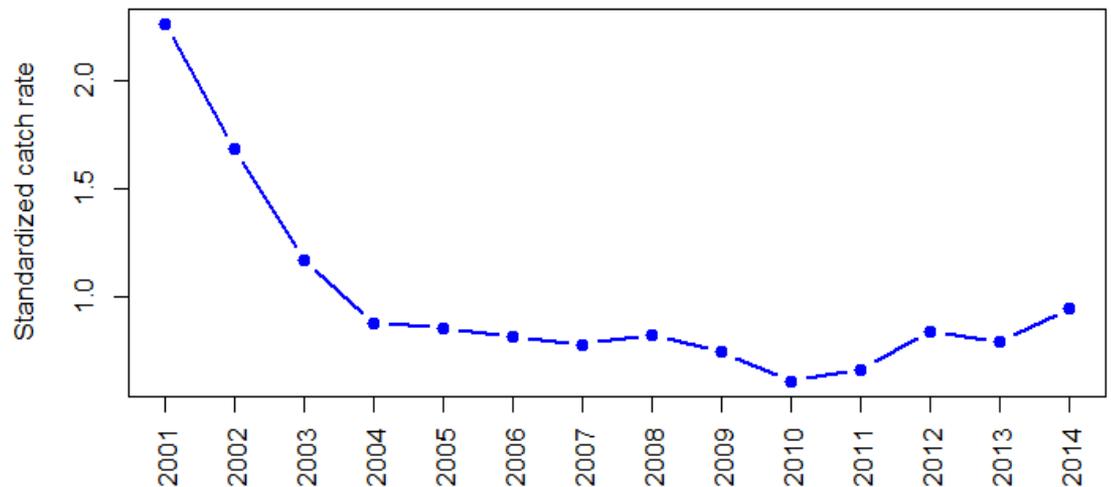
✓ Beverton y Holt (1957)

Seleccionar una “embarcación estándar” y determinar el poder relativo de pesca de todas las otras embarcaciones.

- Datos (IMARPE):
 - Desembarques
 - Esfuerzo: Capacidad de bodega.

$$RFP_i = \frac{C_i/E_i}{C_s/E_s}$$

$$I_t = \frac{\sum_t C_{t,i}}{\sum_i (RFP_i E_{t,i})}$$



Índice de abundancia

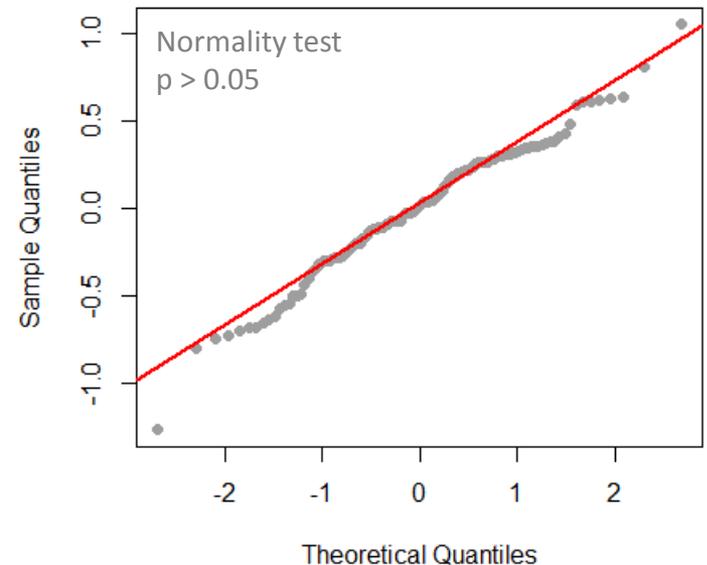
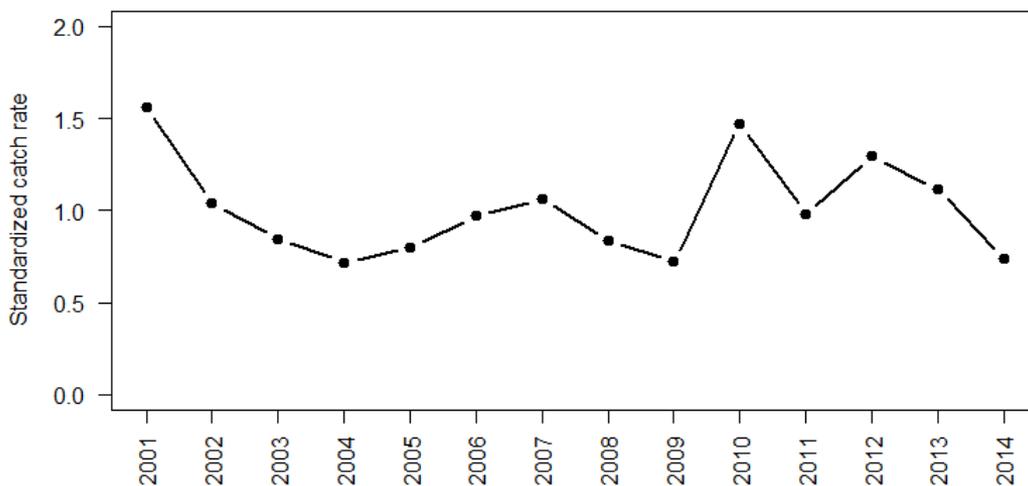
✓ GAM (Maunder & Punt, 2004)

Remover los factores que influyen en la CPUE y **generar un índice de abundancia relativa por año (o periodos)**.

• Data (IMARPE):

- Desembarques (mensuales - viaje)
- Esfuerzo: Capacidad de bodega, N° anzuelos, horas efectivas*
- Variables ambientales (Indice de anomalía : **Niño1+2 SST**).

GAM: $\log(CPUE) \sim Year + season + s(niño12)$



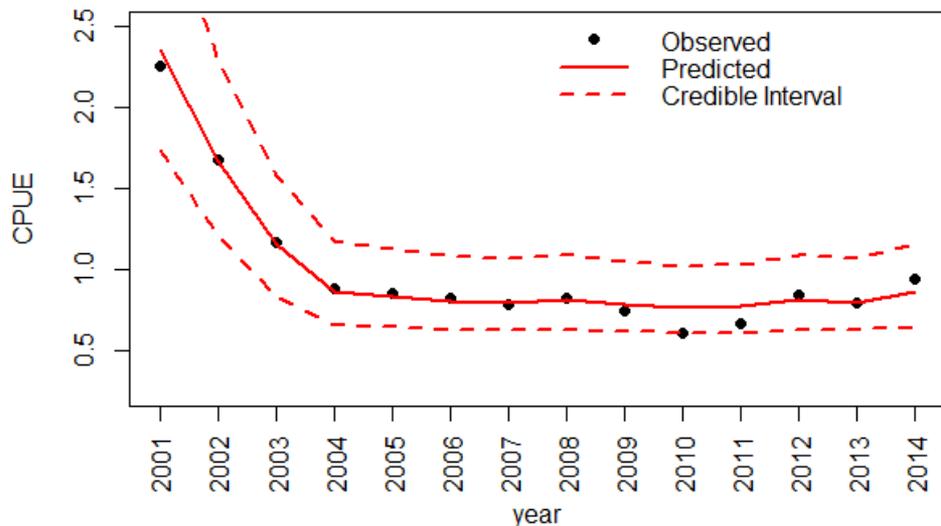
Evaluación de Stocks

- ✓ BUGS in Bayesian stock assessment (Meyer & Millar, 1999)

Input:

- Desembarques (FAO 2001 - 2014)
- CPUE
- Priors (r , K , q , σ^2 , τ^2)

R + JAGS (Just Another Gibbs Sampler)



```
#model in BUGS code
sink("surplusProduction.txt")
cat("
model
{
  # priors K
  K ~ dlnorm(15.92, 10)I(10000, 500000)

  #priors r
  r ~ dnorm(0.6, 500)I(0.01, 1.2)

  #prior q
  iq ~ dgamma(0.001, 0.001)I(0.5, 200) #Non informative prior
  q <- 1/iq

  #priors isigma itau
  isigma2 ~ dunif(0.02, 400) #According to Gelman
  sigma2 <- 1/isigma2

  itau2 ~ dgamma(1.7, 0.01)
  tau2 <- 1/itau2

  #time step [1] conditions
  Pmed[1] <- 0
  P[1] ~ dlnorm(Pmed[1], isigma2)T(0.05, 1.6)

  #time steps of model
  for(t in 2:N){
    Pmed[t] <- log(max(P[t-1] + (r*P[t-1])*(1-P[t-1]) - C[t-1]/K, 0.001))
    P[t] ~ dlnorm(Pmed[t], isigma2)T(0.05, 1.5)
  }

  #Sampling Distribution
  for (t in 1:N)
  {
    lmed[t] <- log(q*K*P[t])
    I[t] ~ dlnorm(lmed[t], itau2)
  }

  #posterior predictions
  index[t] <- log(q*K*P[t])
  I.new[t] ~ dlnorm(index[t], itau2)
}

#additional parameters and predictions
MSP <- r*K/4
EMSP <- r/(2*q)
BMSY <- K/2
P2015 <- P[N] + r*P[N]*(1-P[N]) - C[N]/K
B2015 <- P2015*K
}
```

Evaluación de stocks

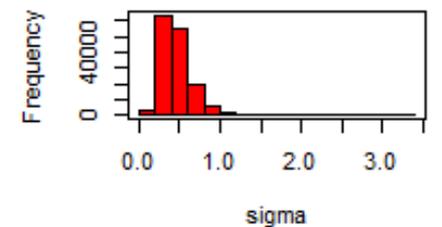
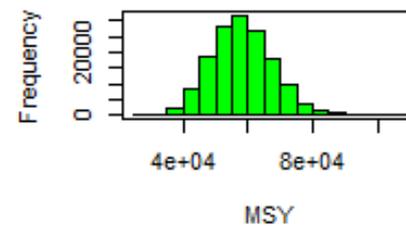
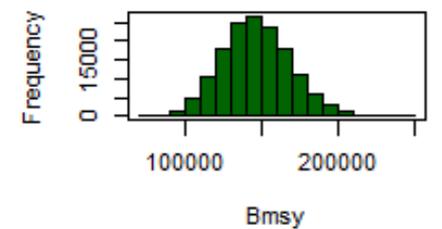
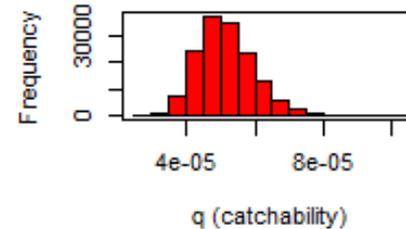
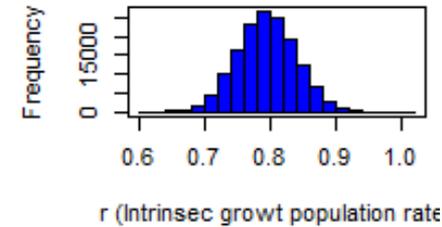
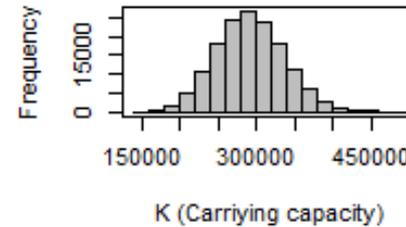
✓ BUGS Bayesian Stock Assessment (Meyer & Millar, 1999)

```
Inference for Bugs model at "surplusProduction.txt", fit using jags,
3 chains, each with 5e+05 iterations (first 1000 discarded), n.thin = 10
n.sims = 149700 iterations saved

mu.vect  sd.vect      2.5%      25%      50%      75%      97.5%  Rhat
BMSY    146349.154  22332.620  104952.278  130831.286  145518.678  161063.435  192412.996  1.001
I.new[1]  2.378      0.389      1.733      2.123      2.338      2.584      3.267  1.001
I.new[2]  1.689      0.266      1.218      1.514      1.669      1.840      2.278  1.001
I.new[3]  1.170      0.183      0.841      1.050      1.158      1.276      1.568  1.001
I.new[4]  0.868      0.126      0.652      0.783      0.857      0.940      1.149  1.001
I.new[5]  0.840      0.119      0.638      0.760      0.830      0.907      1.106  1.001
I.new[6]  0.814      0.111      0.626      0.741      0.804      0.876      1.062  1.001
I.new[7]  0.802      0.108      0.621      0.730      0.791      0.862      1.047  1.001
I.new[8]  0.819      0.113      0.628      0.744      0.808      0.881      1.072  1.001
I.new[9]  0.793      0.107      0.616      0.722      0.782      0.850      1.034  1.001
I.new[10] 0.770      0.101      0.602      0.702      0.759      0.824      1.009  1.001
I.new[11] 0.776      0.103      0.605      0.707      0.765      0.832      1.009  1.001
I.new[12] 0.824      0.114      0.631      0.748      0.813      0.888      1.078  1.001
I.new[13] 0.806      0.109      0.624      0.733      0.795      0.866      1.052  1.001
I.new[14] 0.880      0.129      0.653      0.792      0.871      0.957      1.160  1.001
K        292698.307  44665.239  209904.557  261662.573  291037.357  322126.870  384825.993  1.001
MSP      58052.398   9220.042  41074.776  51626.099  57663.705  64078.980  77092.587  1.001
q         0.000     0.000     0.000     0.000     0.000     0.000     0.000  1.001
r         0.794     0.044     0.707     0.764     0.794     0.824     0.881  1.001
sigma2    0.460     0.191     0.208     0.328     0.422     0.548     0.935  1.001
tau2     0.013     0.008     0.004     0.008     0.011     0.016     0.032  1.001
deviance  -23.969     6.166    -36.165    -27.845    -24.040    -20.159    -11.426  1.001

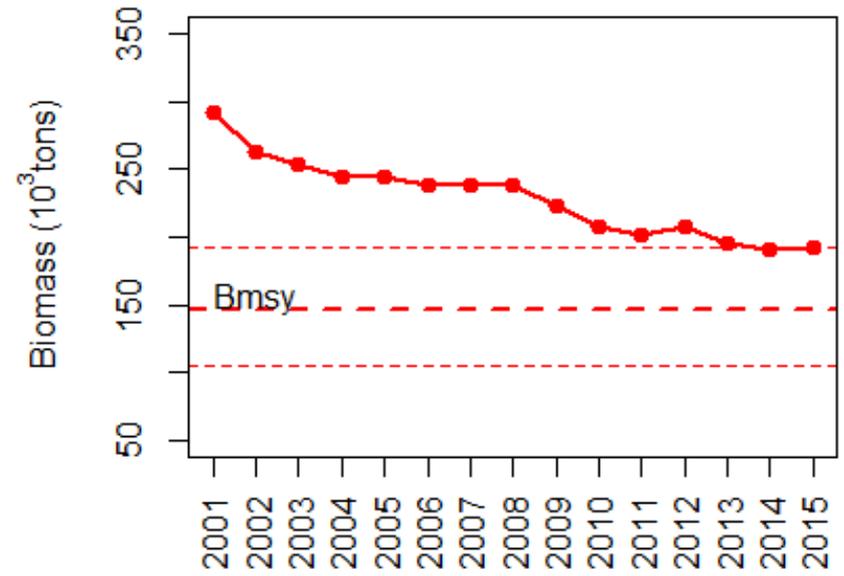
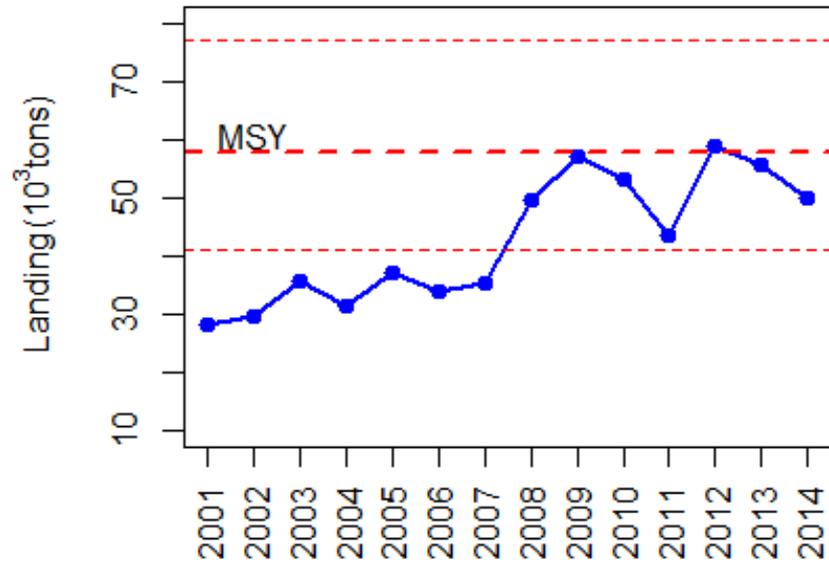
For each parameter, n.eff is a crude measure of effective sample size,
and Rhat is the potential scale reduction factor (at convergence, Rhat=1).

DIC info (using the rule, pD = var(deviance)/2)
pD = 19.0 and DIC = -5.0
DIC is an estimate of expected predictive error (lower deviance is better).
```



Parameters	Median	Credible Intervals
$r(\text{year}^{-1})$	0.794	0.707 - 0.881
$k(t)$	291 037	209 905 - 384 825
$MSY(t)$	58 052	41 074 - 77 093
$B_{MSY}(t)$	145 519	104 952 - 192 413
$q(\times 10^{-5})$	5.08	3.81 - 7.06

Evaluación de stocks



GitHub

<https://github.com/imarpe>

Instituto del Mar del Perú

Callao, Perú <http://www.imarpe.gob.pe>

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Stock assessment models for *Coryphaena hyppurus* (Perico) in Peru
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Validation test for JJM multistock version, Comparison with JJM 2014 for 2014's assessment
Updated on 15 Sep

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Github

<https://github.com/imarpe>

The screenshot shows a web browser window displaying a GitHub repository page. The browser's address bar shows the URL <https://github.com/imarpe/dorado-dolphinfish>. The repository name is "imarpe / dorado-dolphinfish". The page features a navigation bar with "Pull requests", "Issues", and "Gist" links. Below the repository name, there are statistics: "Unwatch" (9), "Star" (0), and "Fork" (0). The main content area displays the repository's commit history and file structure. The commit history shows a list of commits by "ejosymart", including updates to "README.md", "MSY-Catch", "cpue", "surplusProduction", ".gitignore", and "README.md". The file structure shows folders for "MSY-Catch", "cpue", and "surplusProduction", and files for ".gitignore" and "README.md". The "README.md" file is expanded, showing the title "Dorado (Perico - Mahi mahi - dolphin fish)" and the subtitle "Stock assessment models for Coryphaena hyppurus (Perico) in Peru". On the right side, there are links for "Code", "Issues", "Pull requests", "Wiki", "Pulse", "Graphs", and "Settings". At the bottom right, there are options to clone the repository using SSH, HTTPS, or Subversion, and buttons for "Clone in Desktop" and "Download ZIP".

imarpe/dorado-dolphinfish

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Unwatch 9 Star 0 Fork 0

Stock assessment models for Coryphaena hyppurus (Perico) in Peru — Edit

14 commits 1 branch 0 releases 3 contributors

Branch: master dorado-dolphinfish / +

ejosymart Update README.md Latest commit 52d1516 just now

MSY-Catch	MSY-Catch	2 hours ago
cpue	Update cpue_standardization_functions.R	2 months ago
surplusProduction	Update JAGSsurplusProduction.R	3 hours ago
.gitignore	Update .gitignore	2 hours ago
README.md	Update README.md	just now

README.md

Dorado (Perico - Mahi mahi - dolphin fish)

Stock assessment models for Coryphaena hyppurus (Perico) in Peru

SSH clone URL
git@github.com:ima

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Perspectivas

✓ Por hacer:

- Integrating the standardization of catch per unit of effort into stock assessment models (Maunder, 2001).

- Resolución mensual.

✓ Todos están invitados a contribuir (mejorar) los códigos (open source).

✓ Aplicar los códigos desarrollados a la información de otros países (p.ej: MSY - Catch).

GRACIAS

