Tag growth

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1 Introduction

Dissostichus mawsoni

Key words: Antarctic toothfish, Ross Sea

$$\frac{dL}{dt} = a - kL, \tag{1}$$

$$a = \gamma k^{\psi}, \tag{2}$$

When $\psi = 0$ this model become the classic von Bertallanffy.

$$\begin{aligned} \frac{dL}{dt} &= \gamma k^{\psi} - kL, && (3) \\ &= \gamma - kL \quad \text{if} \quad \psi = 0, && (4) \end{aligned}$$

$$\begin{aligned} L_{\infty} &= \frac{\gamma k^{\psi}}{k}, && (5) \\ &= \frac{\gamma}{k} \quad \text{if} \quad \psi = 0, && (6) \end{aligned}$$

$$\begin{aligned} \gamma &= \frac{kL_{\infty}}{k^{\psi}}, && (7) \\ &= kL_{\infty} \quad \text{if} \quad \psi = 0, && (8) \end{aligned}$$

$$L_0 = L_{\infty} \left(1 - e^{kt_0}\right), \tag{9}$$

L_0 is the length at time 0.

$$\begin{aligned} c_v &= \frac{\sigma}{\mu}, && (10) \\ \sigma &= c_v \mu, && (11) \\ \varepsilon &\sim \mathcal{N}\left(0, \sigma_o^2 L_t\right), && (12) \end{aligned}$$

Table 1: .

Parameter	Female	Male
t_0 (y)	0.021	-0.256
k (y^{-1})	0.090	0.093
L_∞ (cm)	180.20	169.07
c_v	0.102	0.012

$c_v = 0.102$.

$$L_t = L_\infty \left(1 - e^{-k(t-t_0)}\right), \tag{13}$$

2 Simulation

Simulated 315 individuals, the same number as in the actual toothfish data set. The next step was to simulate sex, Age1, Age2 and time at liberty. What I did in the current simulation run was:

- Sampled sex from the observed sexes of individuals (with replacement).
- Sampled Age1, Age2 and time at liberty independently (with replacement) from those observed. Randomly selected one of these variables and calculated this values given the other two.
- Rounded Age1, Age2 and time at liberty off to the nearest integer.

This is a bit of a hack I know, but the alternative did not yeild realistic looking Age1, Age2, liberty samples.

2.1 Fits to simulated data

2.1.1 sims1

This was our first attempt at estimating simulated data. L_0 was simulated as 43 and 50 for females and males respectively (Table 2).

L_0 was estimated without a prior penalty. b was treated as a random effect.

80 of 100 fits were pdHess. Looking at the histograms below there seems to be two states that the model estimates are jumping between. Looking at the trace plots, when σ_o is estimated high then the remaining parameters are poorly estimated (Figure 1).

Table 2: .

Parameter	Female	Male
L_0	43	50
$\bar{b}$	0.00100	0.00106
σ_b	0.21	0.19
γ	0.19	0.19
ψ	2e-10	2e-10
σ_o	0.083	0.083
σ_z	0.0	0.0
σ_y	0.0	0.0

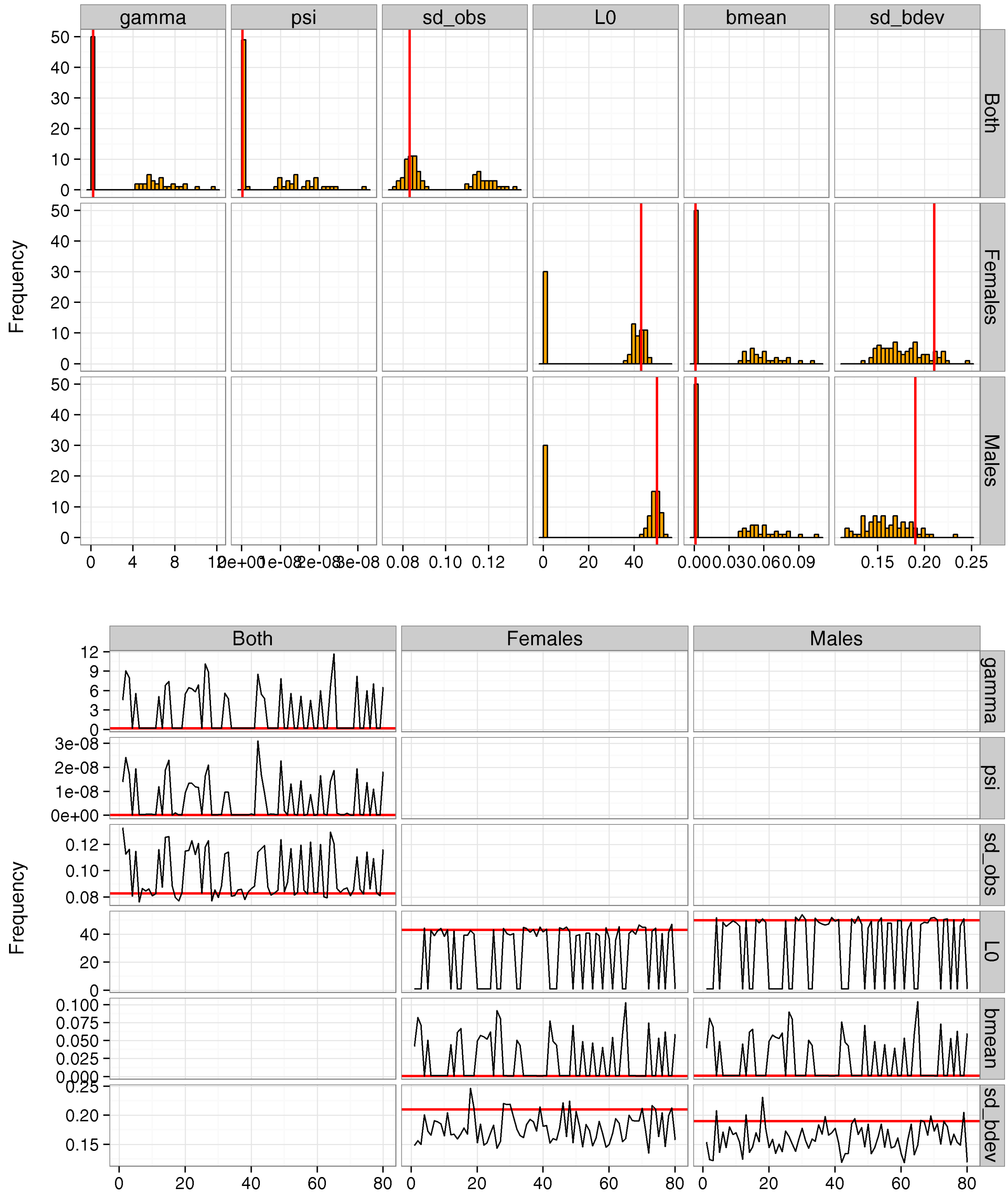

Figure 1: pdH fits plotted only (80 of 100 fits were pdH)..

2.1.2 sims2

The simulation was run with L_0 values much closer to 0 (Table 3).

We placed a prior penalty on L_0 (a normal centered about 0). Again, b was treated as a random effect.

57 of 100 fits were pdHess. Doing a poor job of recovering L_0 for males. Two states that seem to be linked to σ_o again. Not getting ψ at all (Figure 2).

Table 3: .

Parameter	Female	Male
L_0	0.0	6.9
$\bar{b}$	0.003	0.003
σ_b	0.106	0.112
γ	0.4	0.4
ψ	0.001	0.001
σ_o	0.099	0.099
σ_z	0.0	0.0
σ_y	0.0	0.0

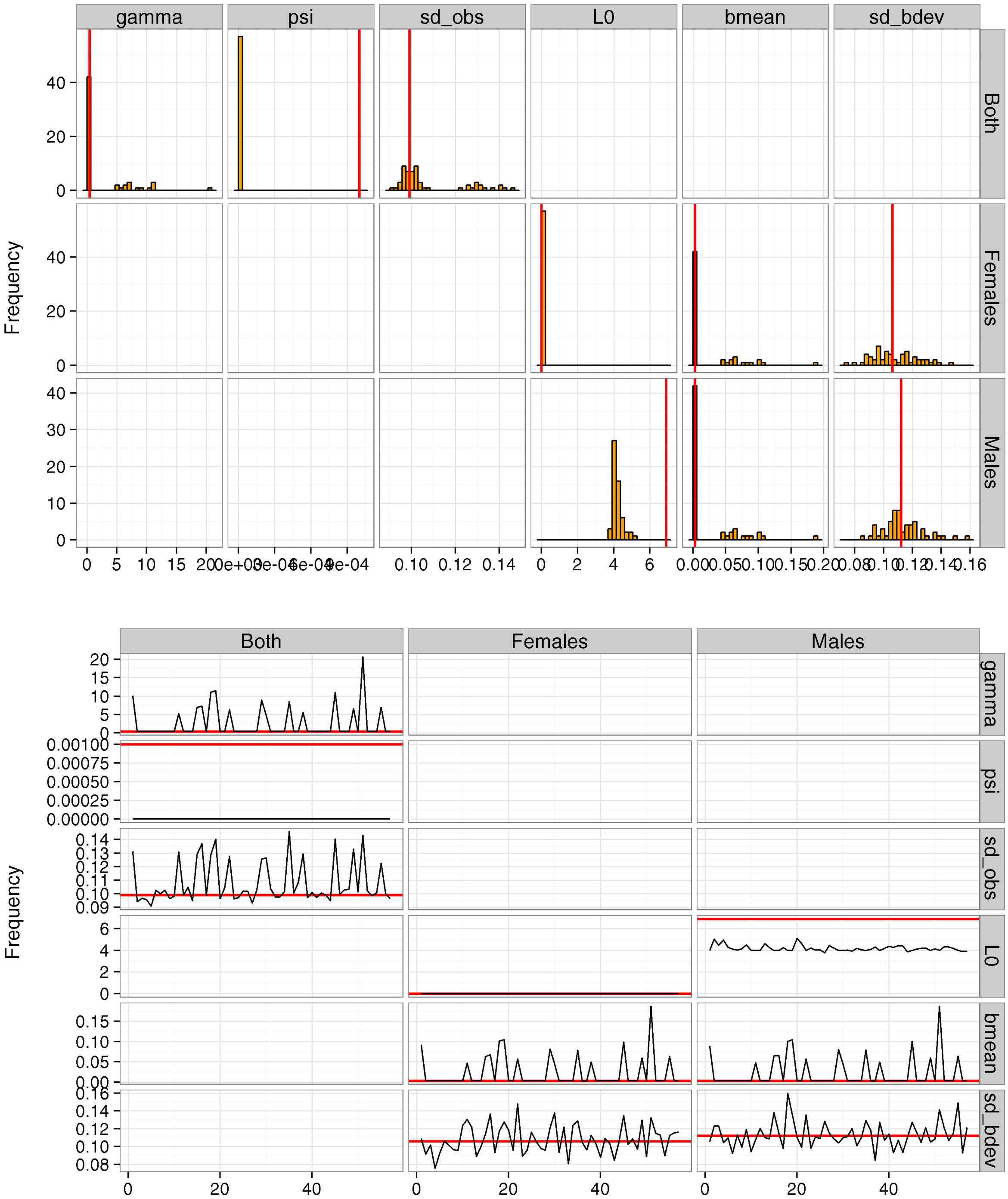

Figure 2: pdH fits plotted only (57 of 100 fits were pdH).

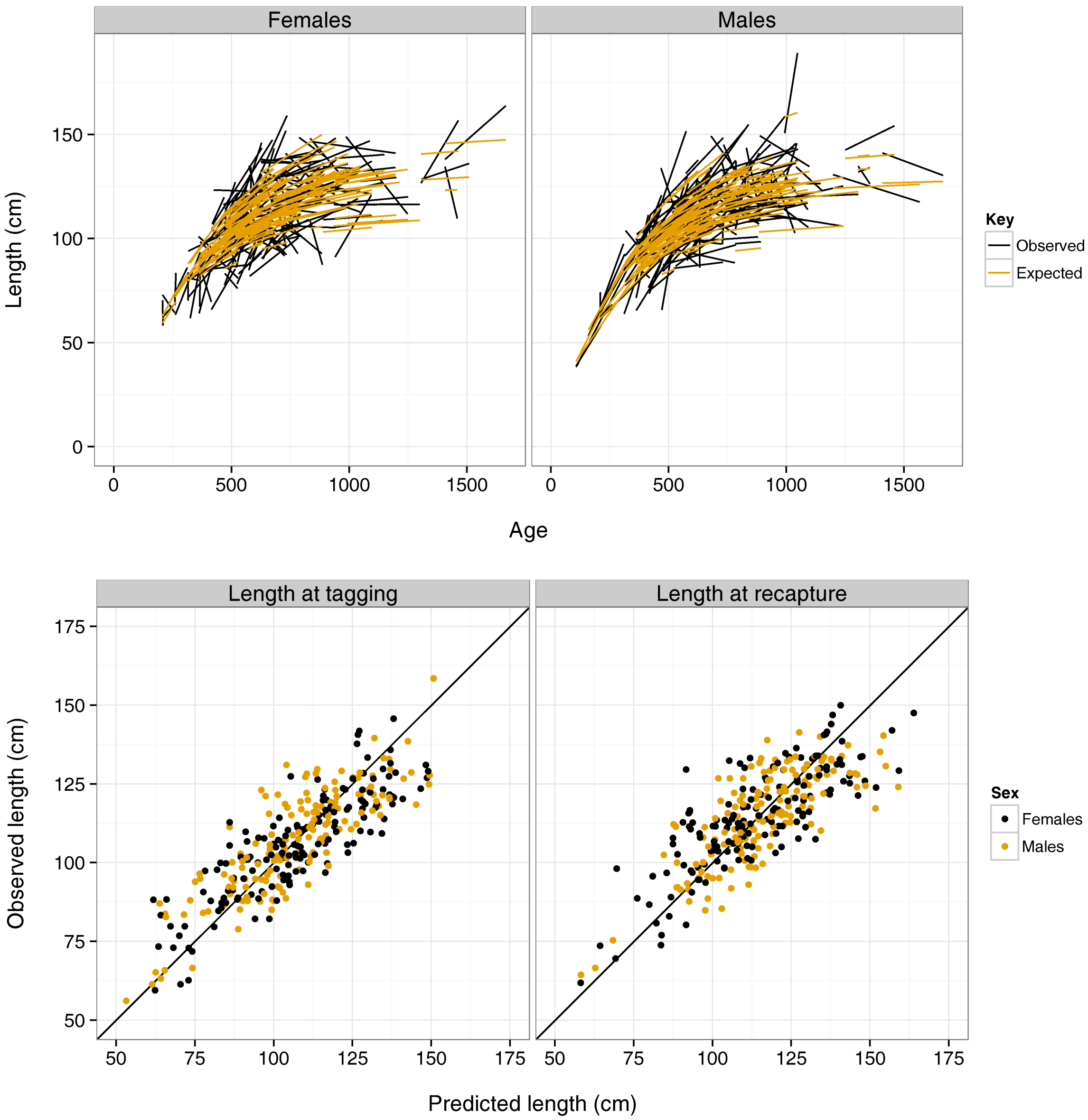

Figure 3: The first pdH simulation (sim 3).