Random effects model Likelihood

$$\sum_{??\ ?}^{?\ ??}\left\{0.5\left(\log(2\pi\sigma_?^?)+\left(\frac{(\widehat{B}_?-B_?)^?}{\sigma_?^?}\right)\right)\right\}+\sum_{??\ ?}^{?\ ??}\left\{0.5\left(\log(2\pi\sigma_?^?\quad)+\left(\frac{(\widehat{B}_?-\hat{B}_{??\ ?})^?}{\sigma_?^?}\right)\right)\right\}$$

log of observed biomass in year i

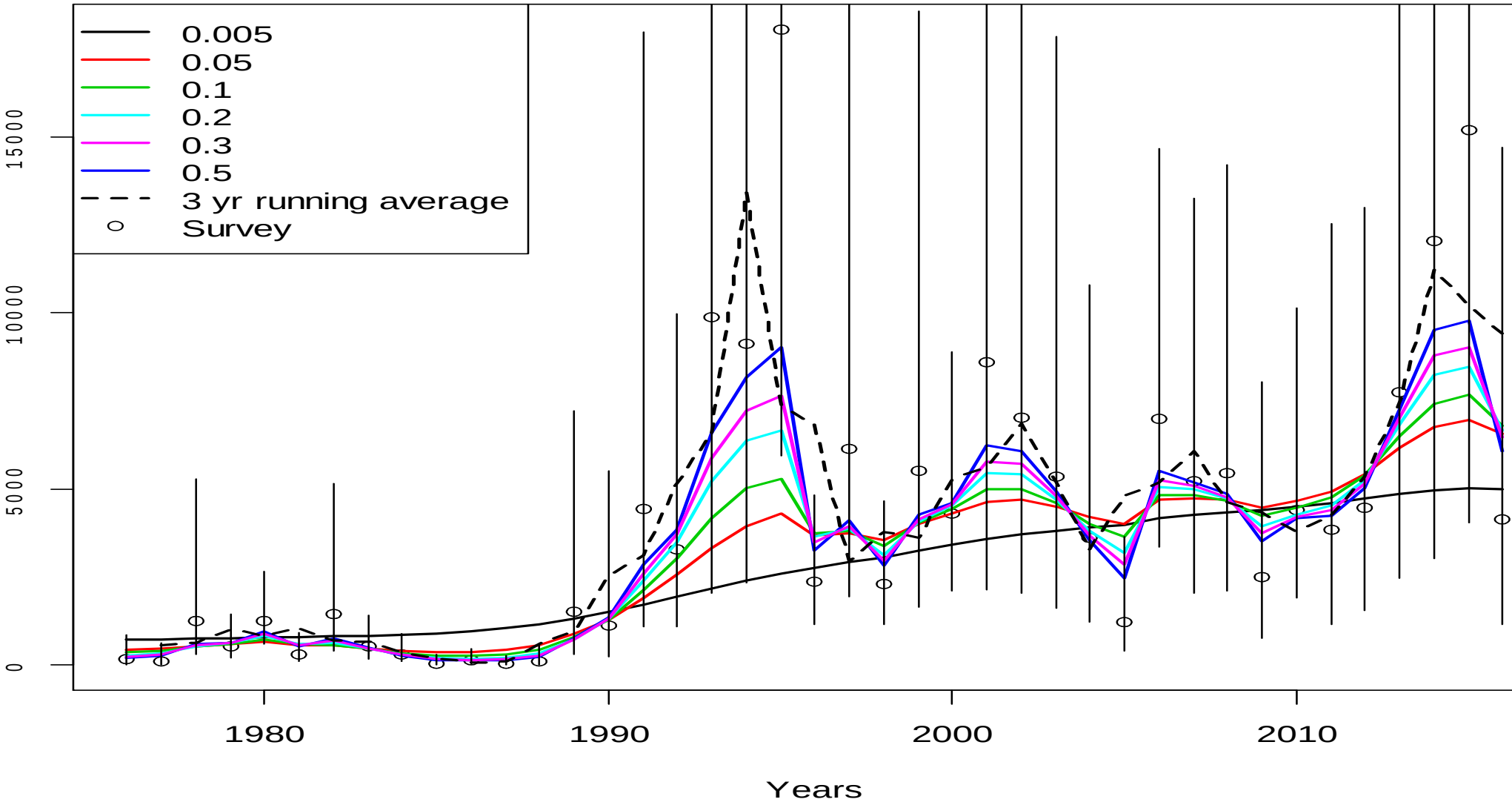
model estimated log biomass in year i

e variance of observed log biomass in year i

e variance of the deviations in log survey biomass between years (i.e. process error variance). $\sigma_?^?$ was estima

here α is a parameter estimated in the random effects model.

e number of years of survey biomass values



e 26. Random effects model estimates of biomass with process error fixed at 0.005, 0.05, 0.1,0.
.5.

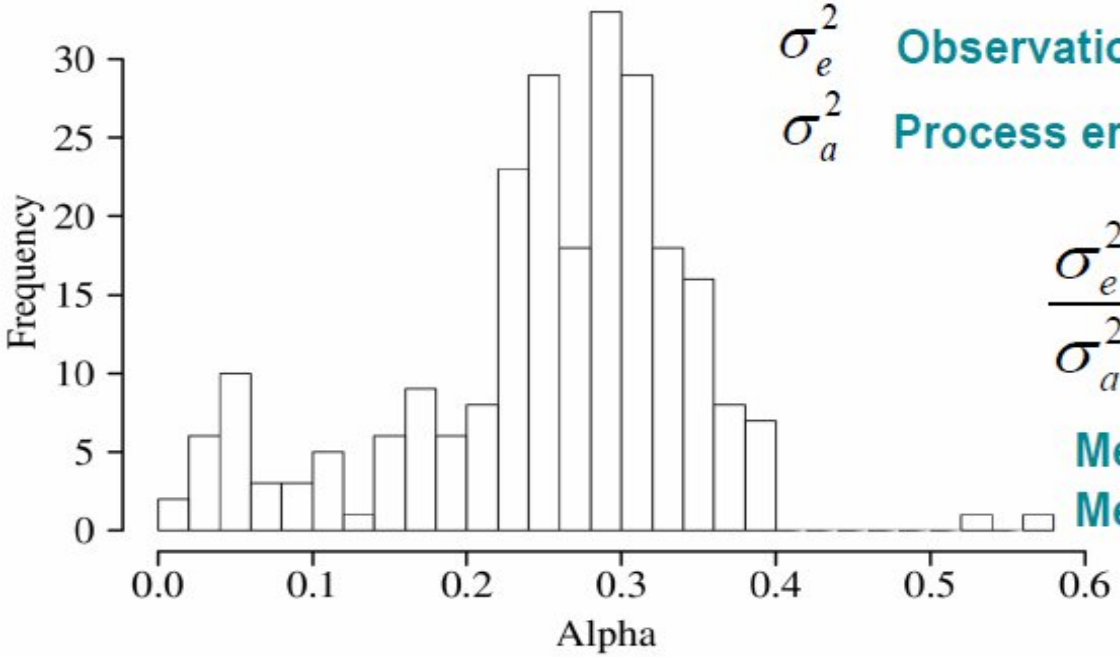
Recommendation of CPT and SSC
Constant cv or se for survey data

- Mean cv of survey data = 0.67 and median = 0.648
- Using constant cv = 0.67 no convergence
- Using constant cv = 0.648 RE model converged at a process error = 0.006.
- Model did not converge using a constant se at the median or average

From Spencer presentation at Wakefield 2015

A simple exponential smoothing model can give information on the ratio of variances

$$\hat{z}_t = (\alpha) y_t + (1-\alpha)\left[\alpha y_{t-1} + \alpha(1-\alpha) y_{t-2} + \alpha(1-\alpha)^2 y_{t-3} + \ldots\right]$$



σ_e^2 Observation error variance

σ_a^2 Process error variance

$$\frac{\sigma_e^2}{\sigma_a^2} = \frac{1-\alpha}{\alpha^2}$$

Mean α = 0.256

Mean ratio = 11.35

Observation error variance on log scale is ln(cv^2+1)

Mean cv of survey biomass is 0.67

Mean Observation Error variance on log scale = 0.38

Fitting a simple exponential model to Pribilof survey data using HoltWinters function in R gives,

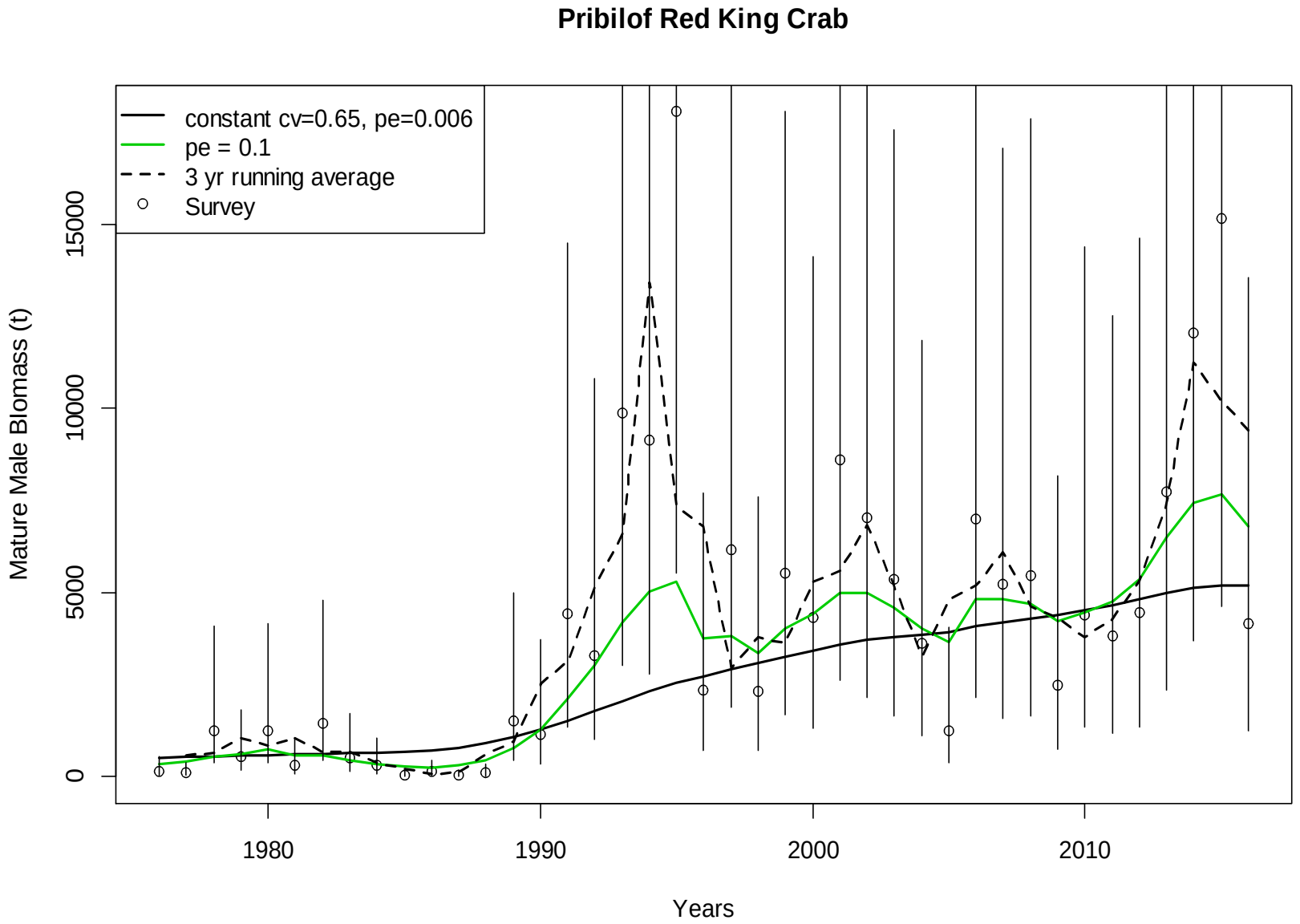
Alpha = 0.396,

variance ratio $(1-\alpha)/\alpha^2 = 3.75$ and,

process error = 0.38/3.75 = 0.102.

Pribilof red model variance of first difference in log biomass = 0.046, Bristol Bay red king crab model = 0.089.

gure 2. Random effects model estimates of Mature male biomass with process rror estimated where cv of biomass was set at 0.648 for all years (pe=0.006), fixed t 0.1, and biomass estimated using the 3-year running average. Approximate ognormal confidence intervals were estimated using a constant cv = 0.648.

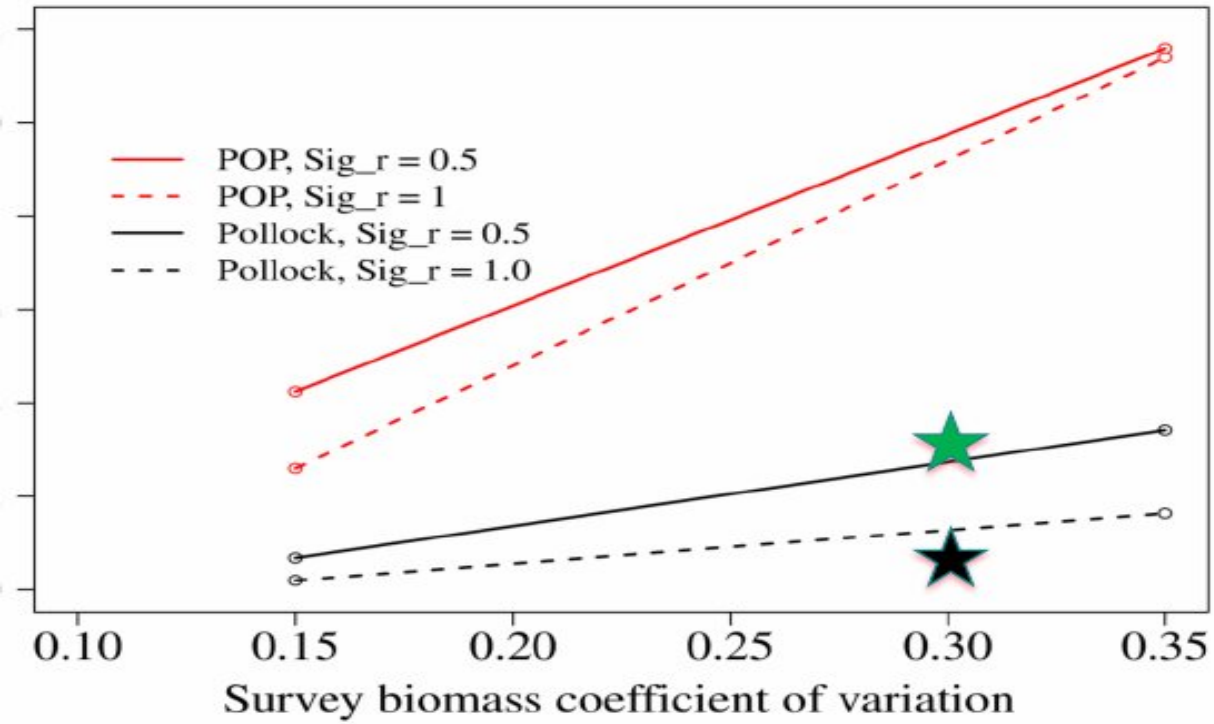


Alternatives?

- Continue using running average model
- Use random effects model with constant cv = 0.648 – results in very smooth curve with process error = 0.006.
- Fix process error at some value (between 0.1 to 0.05)
- Use a prior on process error with mean between 0.1 and 0.05 and variance ??

Spencer Wakefield 2015

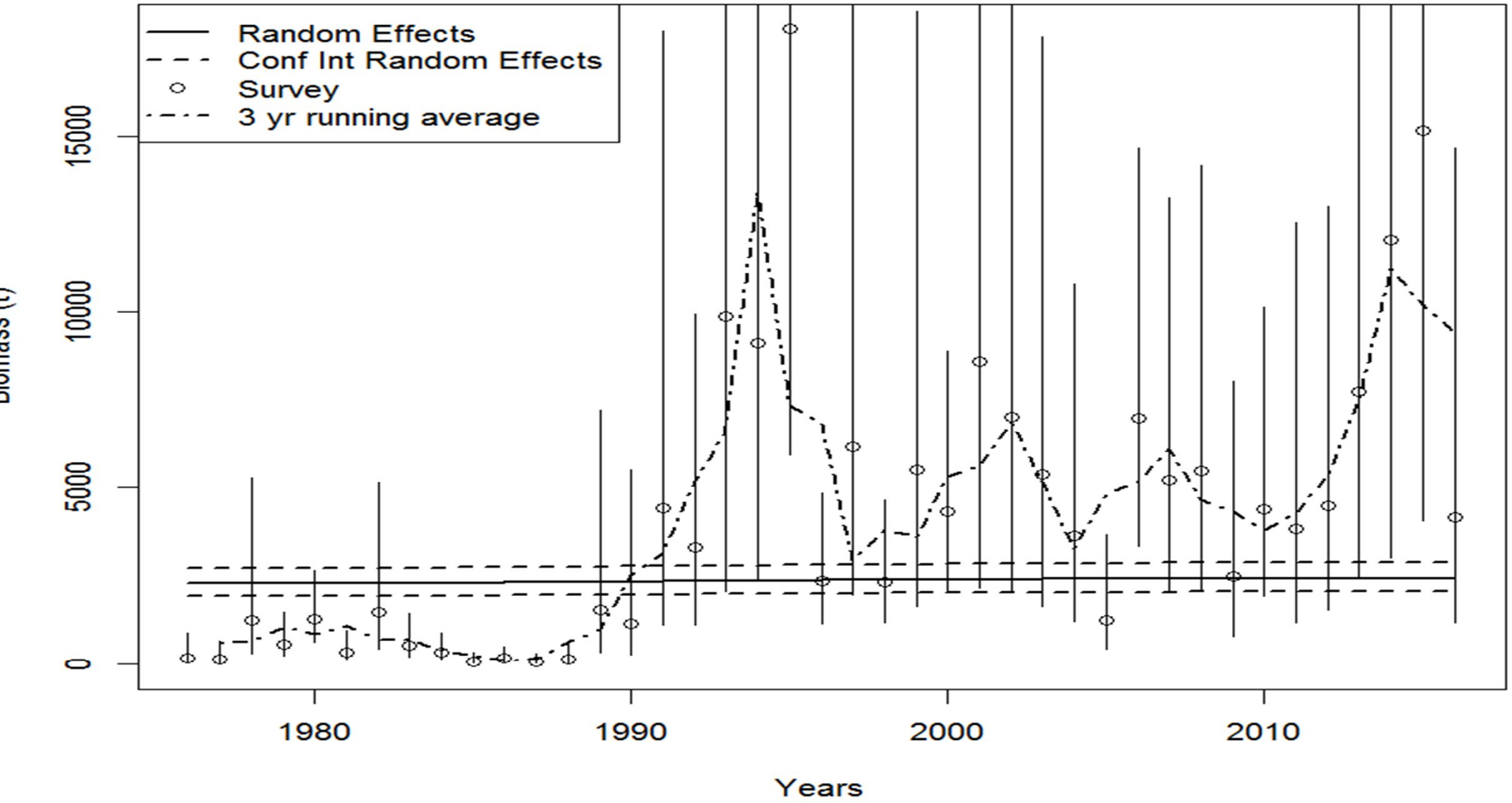
The variance ratio is a function of stock longevity, recruitment variability, and survey variability



Used as a prior to constrain the estimate of process error standard deviations

Implied from fit to GOA dogfish

Survey biomass in 2016 declined to 4,150 t from 15,173 t in 2015



re 14. Three-year running average and random effects model fit to male biomass > 120mm at surv
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