



COMPARISON OF LENGTH BASED GROWTH
RATES FROM MODELS FIT SEPARATELY TO
HIGH CONFIDENCE TAGGING DATA AND
LENGTH AT AGE DATA BASED ON ANNUAL
INCREMENT COUNTS (DECIMAL AGE) FROM
BIGEYE OTOLITHS FROM THE WCPO

MATTHEW VINCENT

OUTLINE

- Otolith Only von Bertalanfy Growth Curve
 - Data
 - Model Fit and Parameters estimates
- Integrated Otolith and Tag Increment von Bertalanffy
 - Data
 - Model Used
 - Parameter Estimate
- Comparison of Parameter Estimates

OTOLITH ONLY VON BERTALANFFY DATA



- Otoliths from Bigeye captured in the WCPO (i.e., West of 210°)
- 926 Annually aged otoliths by FAS with assumed birthday
- 30 Daily aged otoliths by FAS
- 28 Daily age otoliths by SPC
- Total 984 otoliths

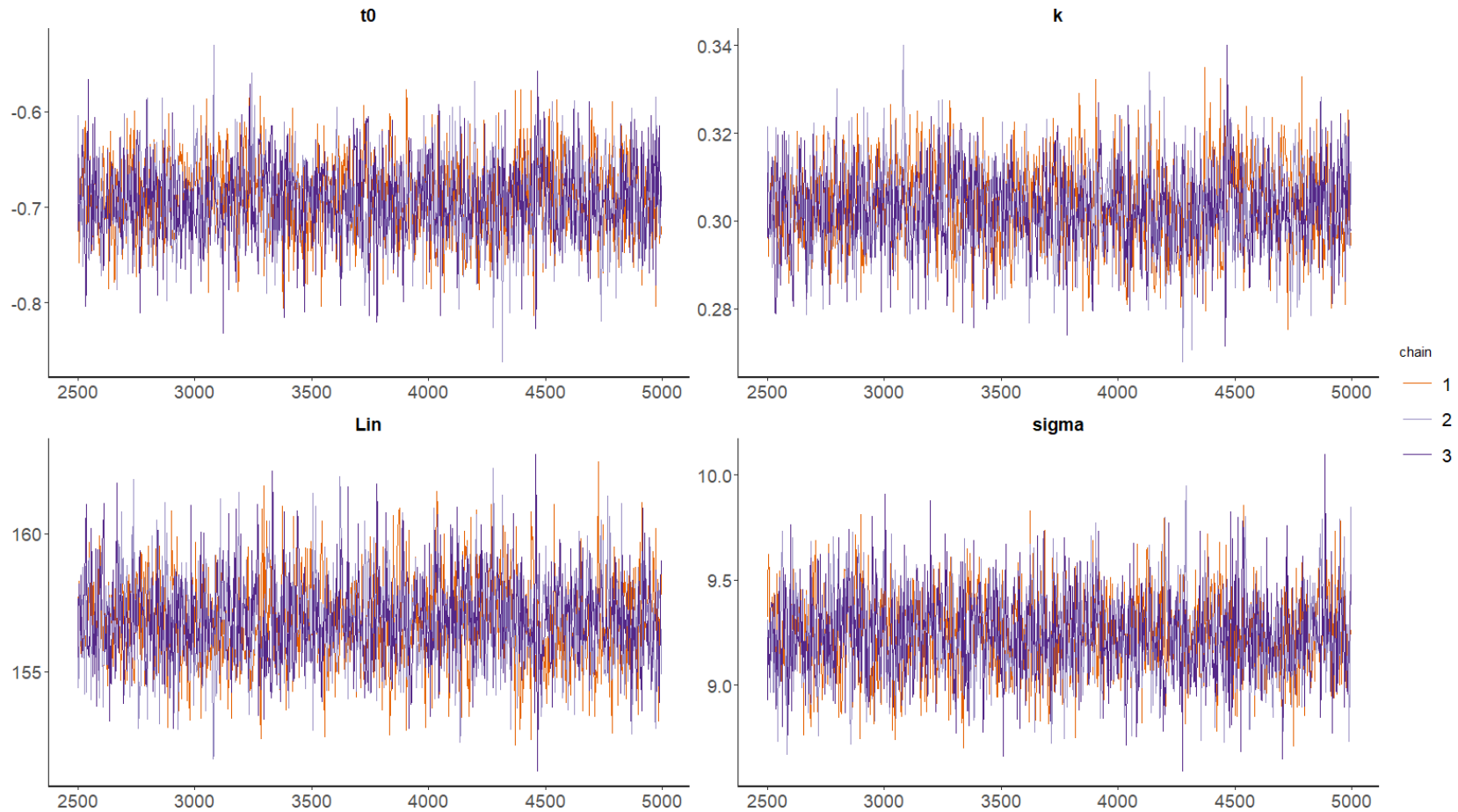
OTOLITH ONLY VON BERTALANFFY MODEL

- Fit von Bertalanffy model for otolith length at age likelihood
- $l_i \sim \text{normal}(\mu_i, \sigma)$
- $\mu_i = L_\infty * (1 - \exp(-k * (a_i - t_0)))$
- $t_0 \sim \text{normal}(0, 100)$
- $1/k \sim \text{uniform}(0, 100)$
- $L_\infty \sim \text{uniform}(0, 10000)$
- $\sigma \sim \text{uniform}(0, 10000)$

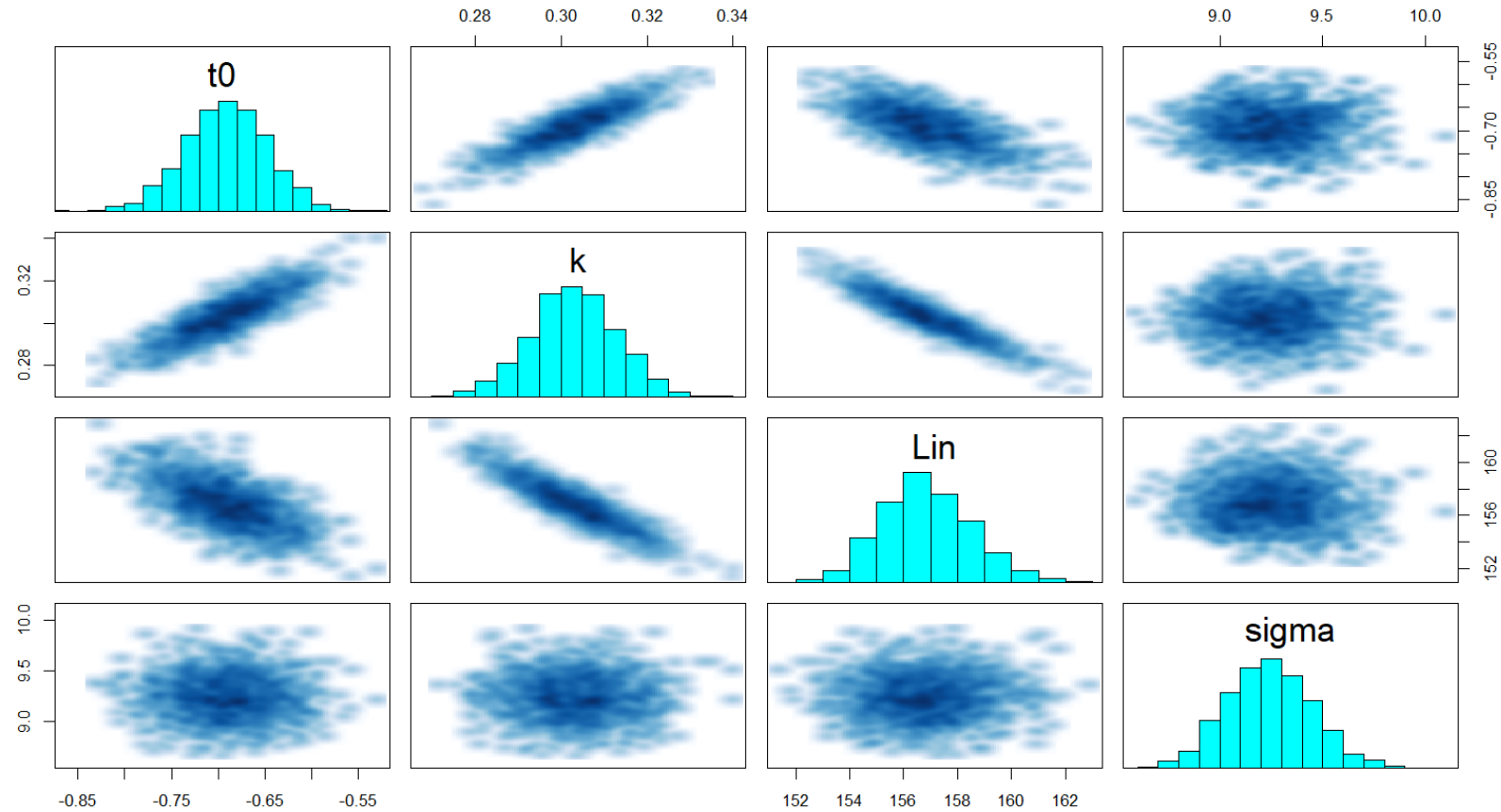
OTOLITH ONLY VON BERTALANFFY MODEL

- Used Stan MCMC methods with 3 chains
 - each with iter=5000; warmup=2500; thin=3
 - post-warmup draws per chain=834
 - total post-warmup draws=2502

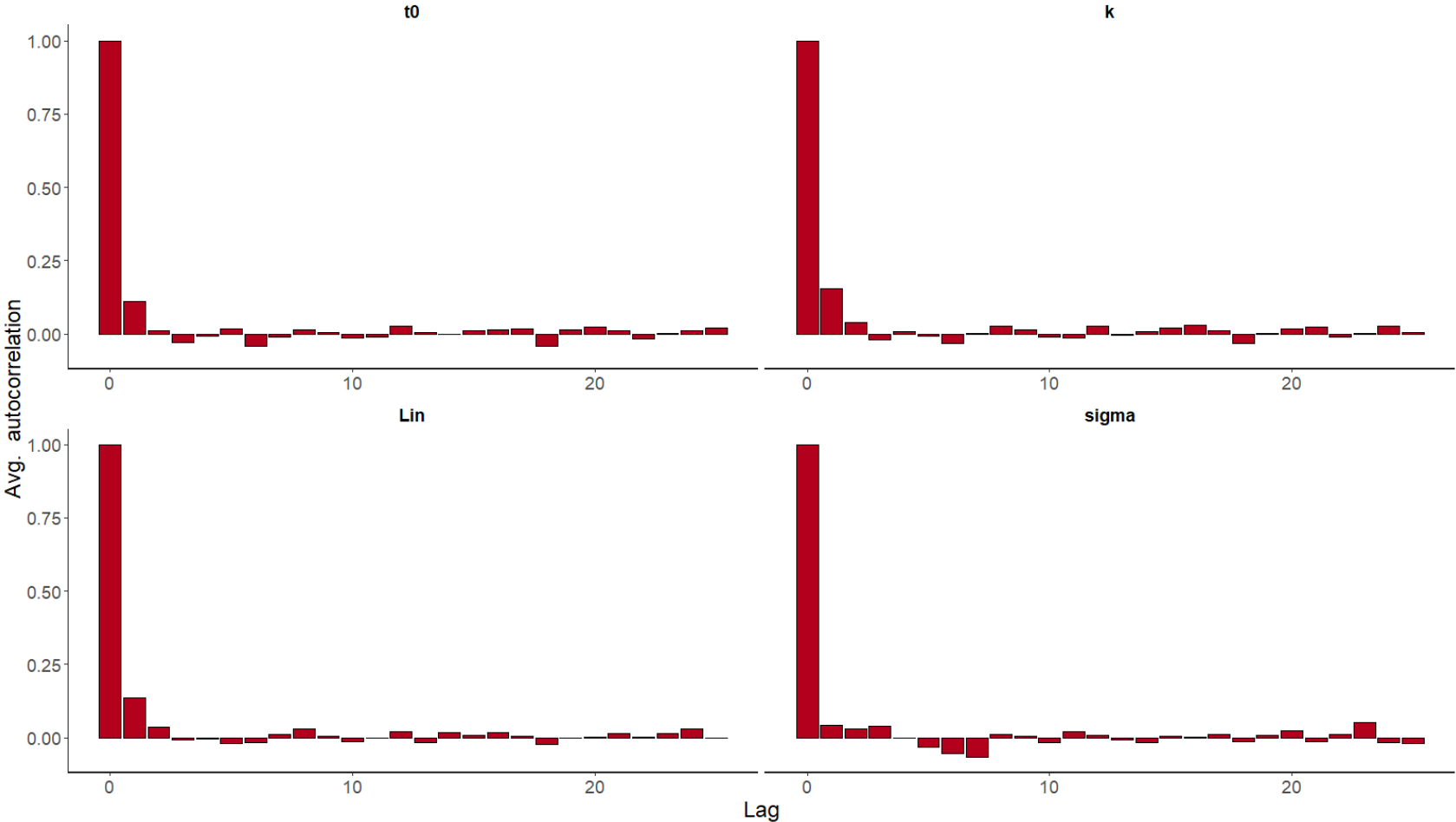
OTOLITH ONLY VON BERTALANFFY TRACE PLOTS



OTOLITH ONLY VON BERTALANFFY MARGINAL DISTRIBUTION PLOTS

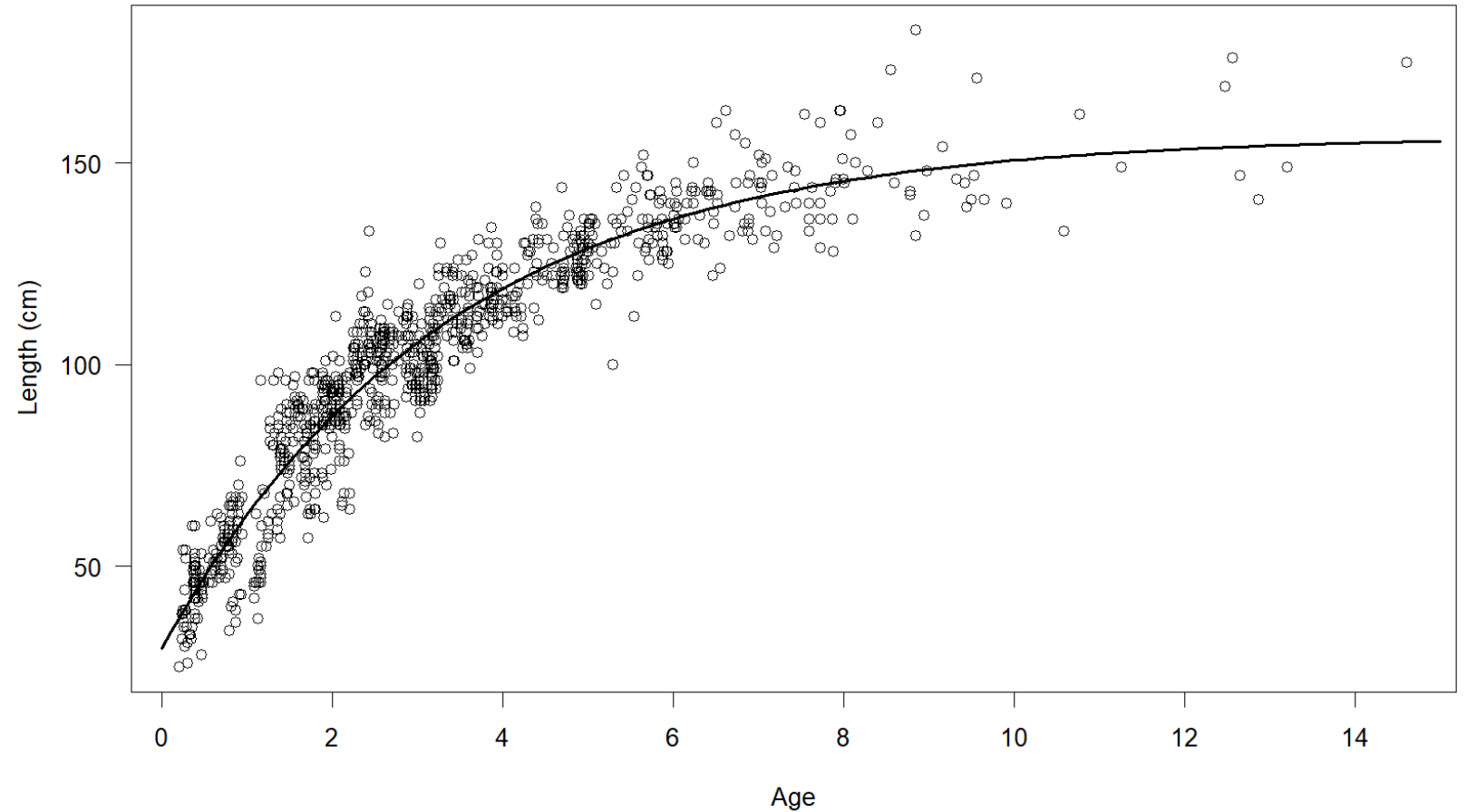


OTOLITH ONLY VON BERTALANFFY AUTOCORRELATION



OTOLITH ONLY VON BERTALANFFY PARAMETER ESTIMATES

	Otolith Only
t_0	-0.69
L_∞	156.85
k	0.30
σ	9.24

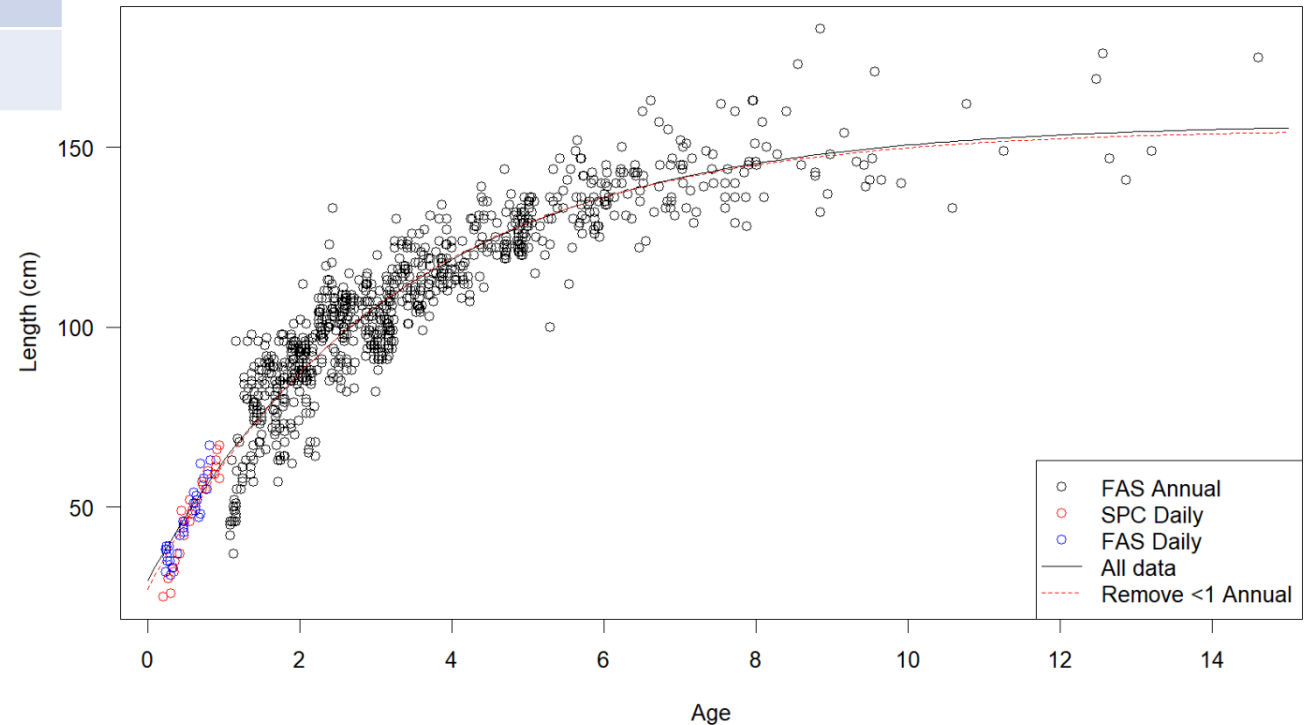


MODEL WITH ONLY DAILY AGES FOR FISH LESS THAN 1 YEAR OLD

- Ages for fish less than 1 year are highly dependent on the assumed date of birth
- Removed all fish with decimal age less than 1 year that had not been aged by daily ring counts
- Fit a Bayesian Model in Stan

DAILY AGES ONLY FOR FISH <1 YEAR OLD PARAMETER ESTIMATES

	No <1 yr old annual	Otolith Only
t_0	-0.61	-0.69
L_∞	155.29	156.85
k	0.317	0.30
σ	9.282	9.24



INTEGRATED VON BERTALANFFY DATA



- 984 otoliths used in previous analysis
- Incorporates length increments from high quality tag recoveries measured by Japanese scientist or port samplers
 - Filtered for > 180 days at liberty
- Release length, recapture length and time at liberty from 612 tagged fish

INTEGRATED VON BERTALANFFY MODEL

- Three likelihood components

1. Otoliths: length at age

- $I_i \sim \text{normal}(\mu_i, \sigma)$ $\mu_i = \underline{L}_i^*(1 - \exp(-k^*(a_i - t_0)))$

2. Tags: length at release

- $I_{1j} \sim \text{normal}(\mu_j, \sigma)$ $\mu_j = \underline{L}_i^*(1 - \exp(-k^*(t_j - t_0)))$

3. Tags: length at recapture

- $I_{2j} \sim \text{normal}(\mu_j, \sigma_c)$ $\mu_j = \underline{L}_i^*(1 - \exp(-k^*(t_j + \Delta_j - t_0)))$

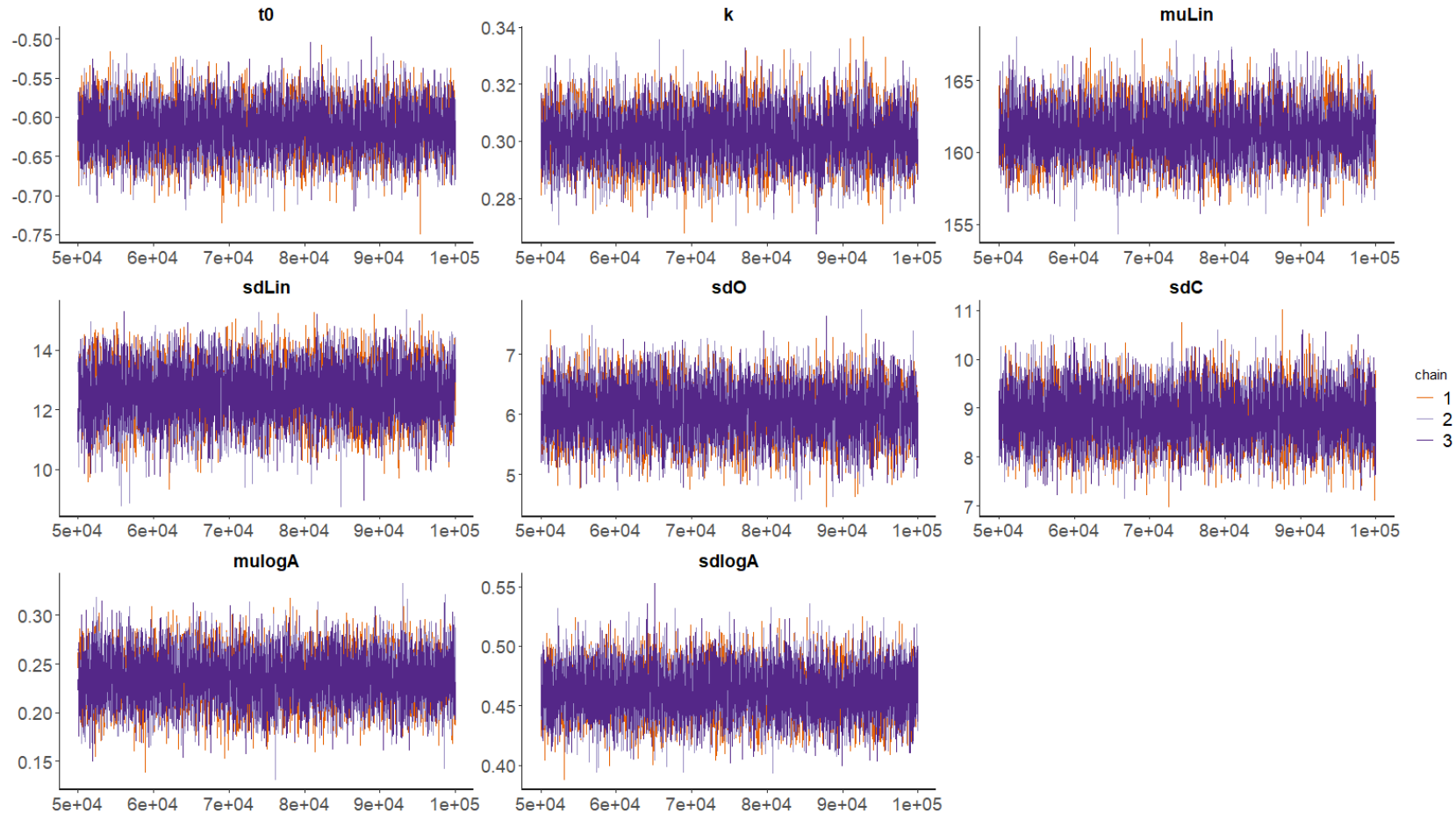
INTEGRATED VON BERTALANFFY MODEL PRIORS

- $L_i, L_j \sim \text{normal}(\mu_\infty, \sigma_\infty)$
- $\mu_\infty \sim \text{normal}(0, 1000)$
- $\sigma_\infty \sim \text{uniform}(0, 100000)$
- $t_0 \sim \text{normal}(0, 100)$
- $1/k \sim \text{uniform}(0, 100)$
- $\sigma \sim \text{uniform}(0, 100);$
- $\sigma_c \sim \text{uniform}(0, 100);$
- $t_j \sim \text{LN}(\mu_a, \sigma_a)$
- $\mu_a \sim \text{normal}(0, 1000)$
- $\sigma_a \sim \text{uniform}(0, 100)$

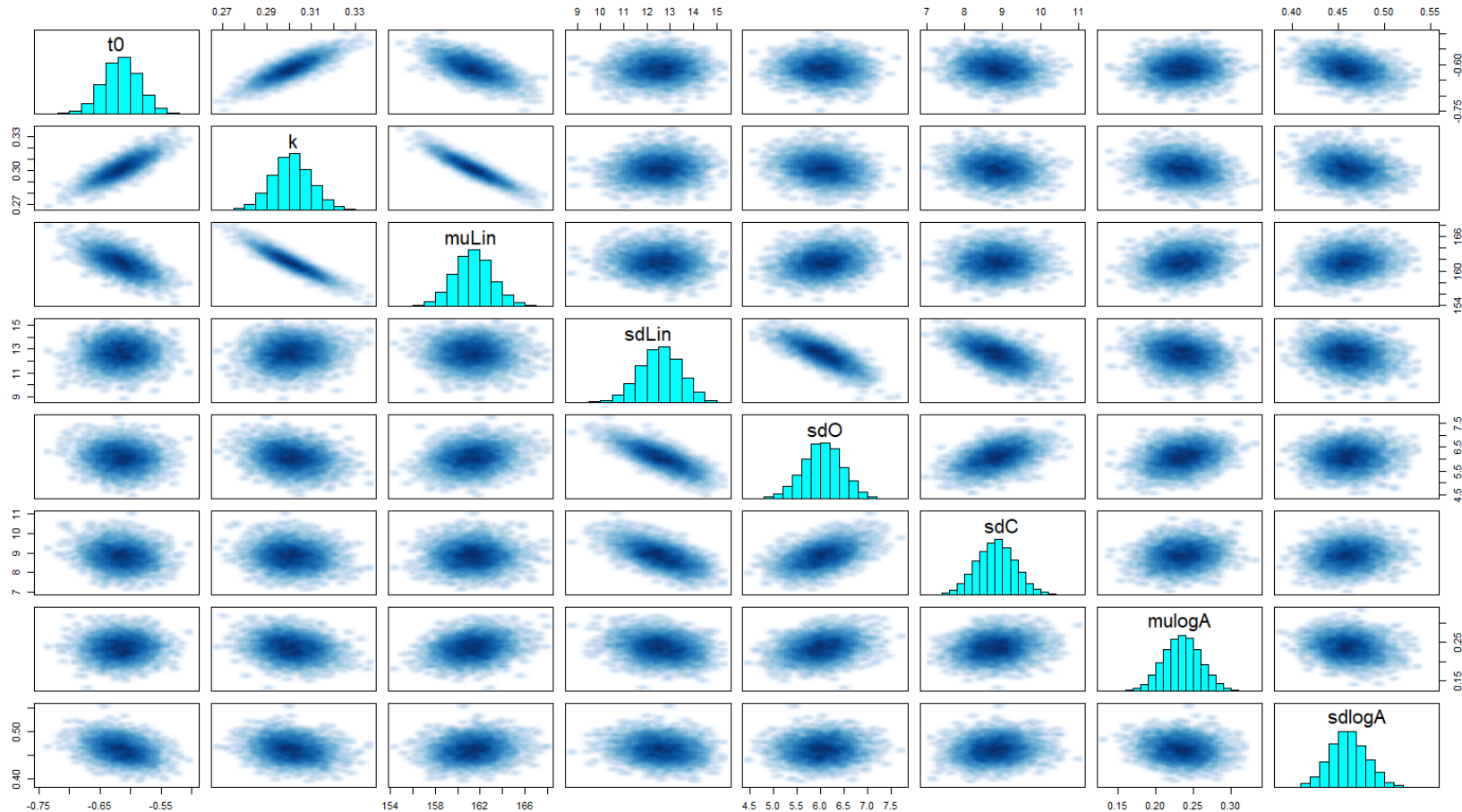
INTEGRATED VON BERTALANFFY MODEL FITTING

- 3 chains, each with iter=100,000; warmup=50,000; thin=15;
- post-warmup draws per chain=3334, total post-warmup draws=10002.

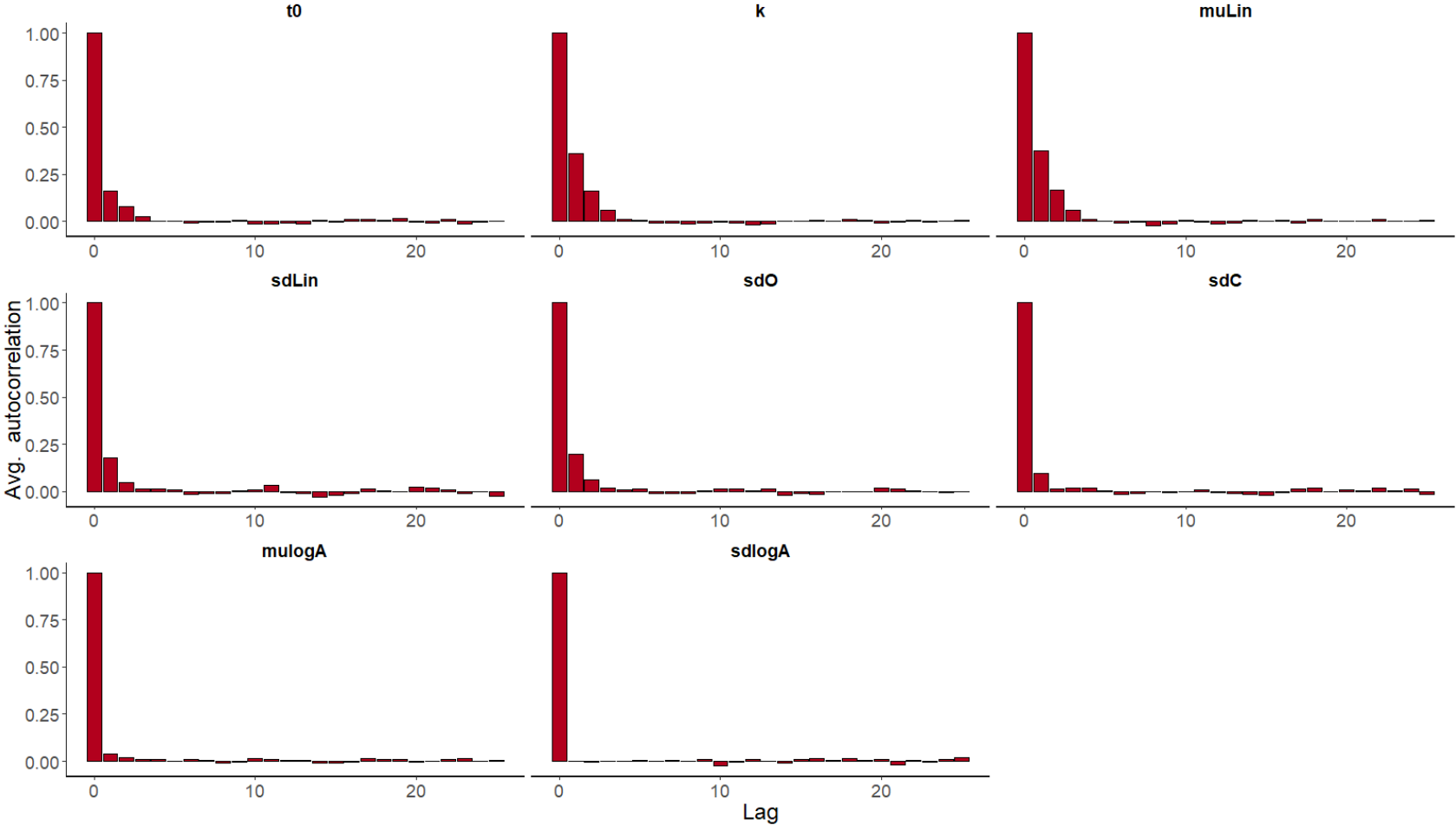
INTEGRATED VON BERTALANFFY TRACE PLOTS



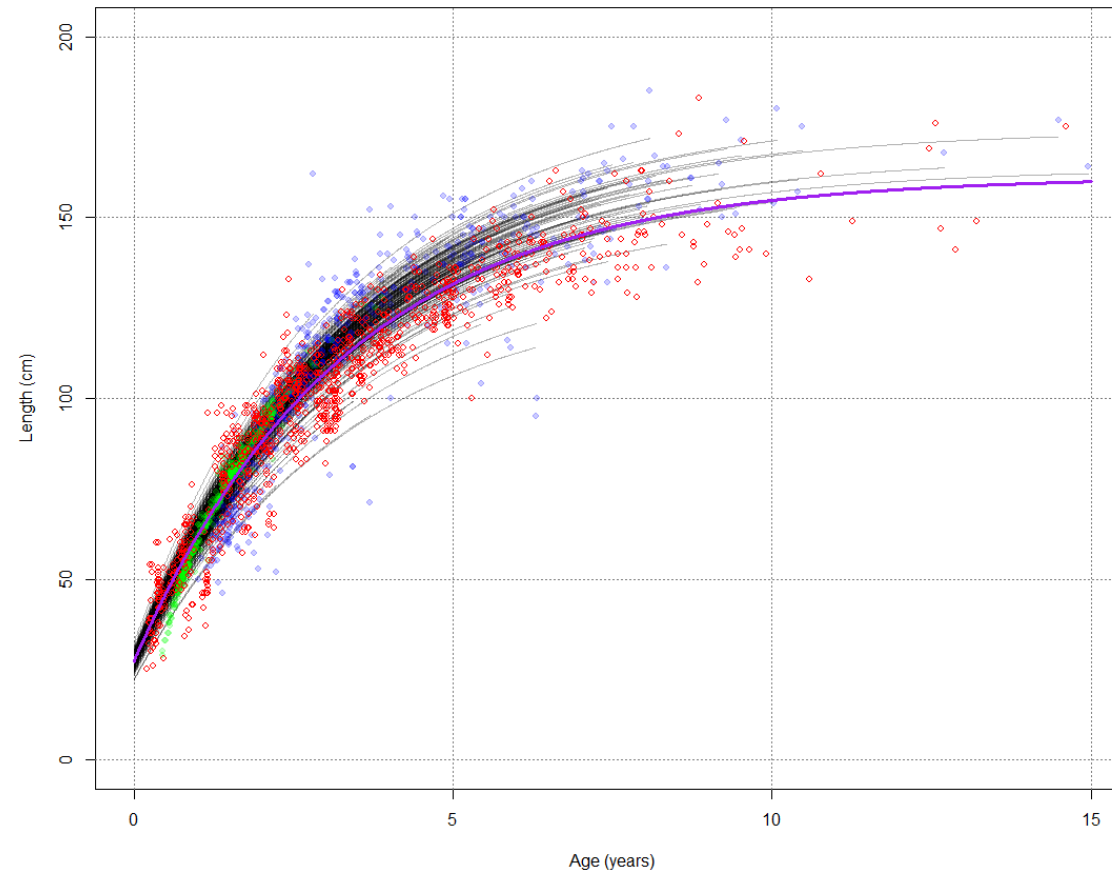
INTEGRATED VON BERTALANFFY MARGINAL DISTRIBUTION PLOTS



INTEGRATED VON BERTALANFFY AUTOCORRELATION



INTEGRATED VON BERTALANFFY PARAMETER ESTIMATES

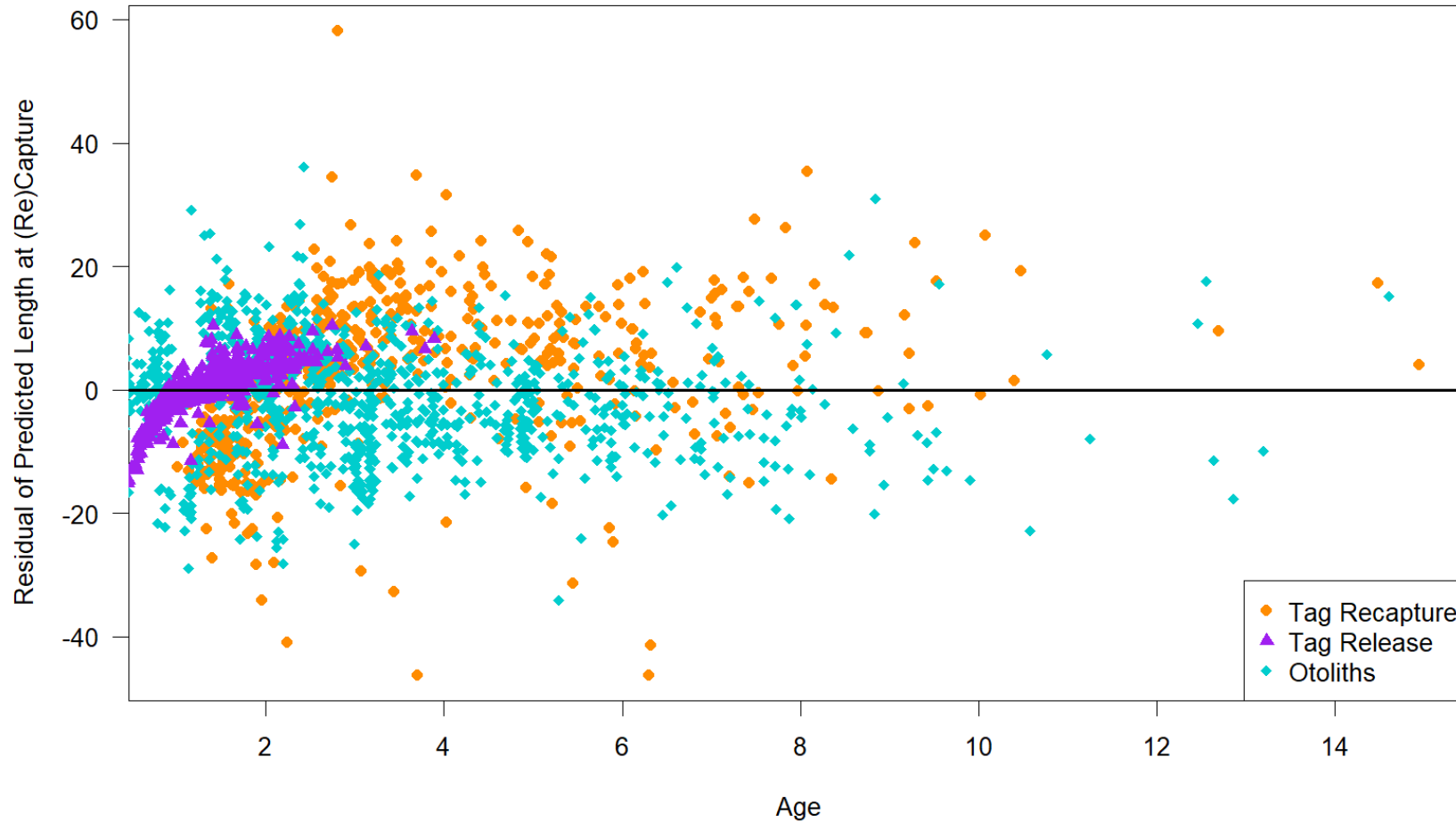


Release
Recapture
Otolith

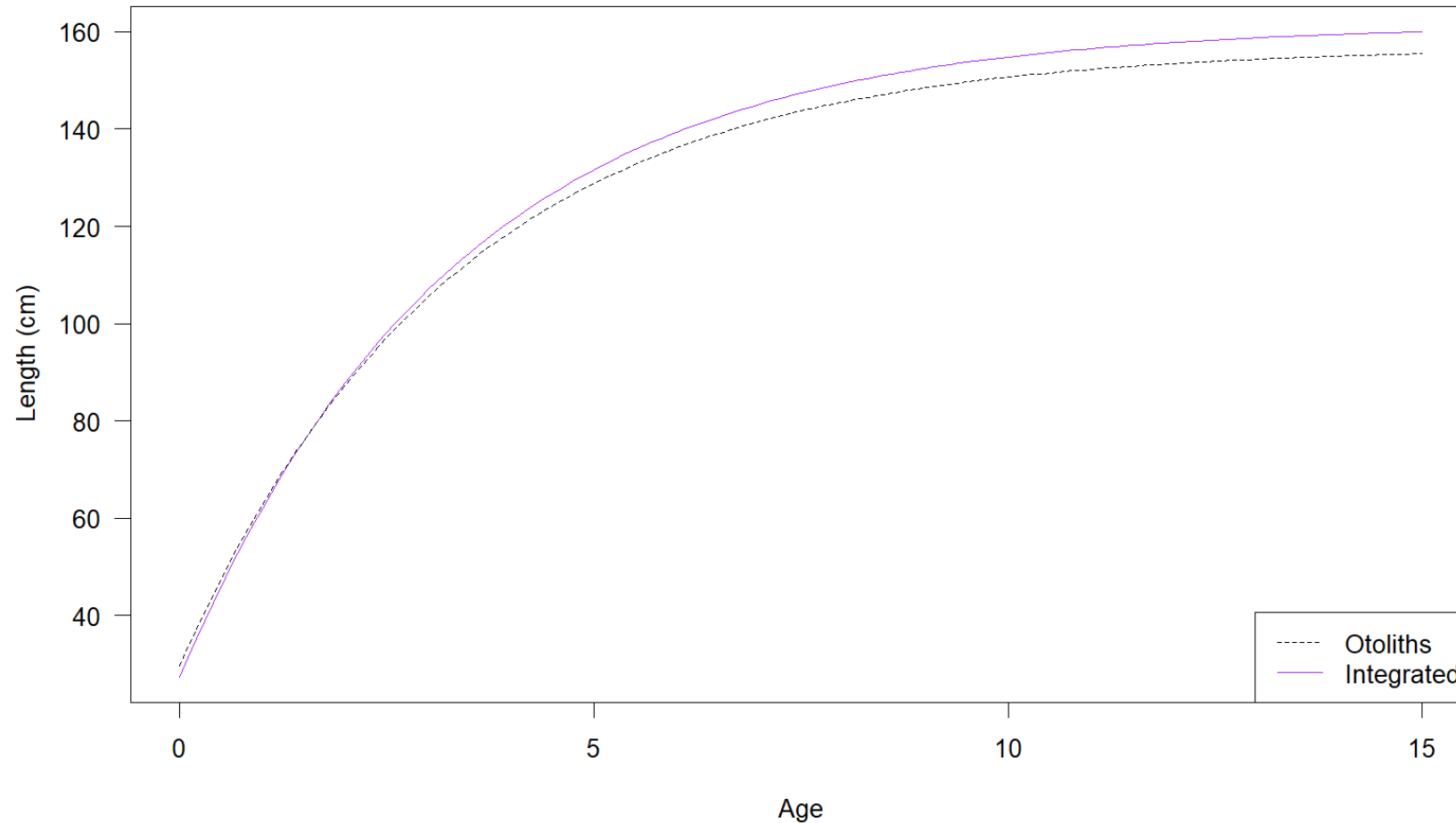
INTEGRATED VON BERTALANFFY PARAMETER ESTIMATES

	Integrated	No < 1 yr old annual	Otolith Only
t_0	-0.61	-0.61	-0.69
L_∞	161.37	155.29	156.85
k	0.30	0.317	0.30
σ	6.05	9.282	9.24
σ_∞	12.57	NA	NA
σ_c	8.82	NA	NA
μ_a	0.24	NA	NA
σ_a	0.46	NA	NA

INTEGRATED VON BERTALANFFY RESIDUALS



COMPARISON OTOLITH ONLY AND INTEGRATED TAG GROWTH CURVES



SUMMARY

- Tag Integrated von Bertalanffy model has higher L_{∞}
- Otolith Only model used in stock assessment
- Estimate of k and t_0 are relatively insensitive to model

	Integrated	No <1 yr old annual	Otolith Only
t_0	-0.61	-0.61	-0.69
L_{∞}	161.37	155.29	156.85
k	0.30	0.317	0.30
σ	6.05	9.282	9.24
σ_{∞}	12.57	NA	NA
σ_c	8.82	NA	NA
μ_a	0.24	NA	NA
σ_a	0.46	NA	NA

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