

Section S1. Sample Trips to Singapore Fishery Ports

Table S1. Summary of the sample trips to the Fishery Ports and the cost of the wedgefish samples purchased. Size class indicates the estimated size at collection at the fishery ports; sample type if the animal was whole, tailed, or trunked; fins attached (yes or no) if samples had dorsal, second dorsal and caudal fins removed prior to the sample collection; fishery port sampled Senoko Fishery Port (SFP) and Jurong Fishery Port (JFP); import country from the casual discussions from the fish merchants; individual purchase cost of samples if available; combined total purchase cost for samples that were purchased together; -- indicate information was not recorded/available

Day	Month	Year	Sex	Size class	Sample type	Fins attached	Fishery port	Import country	Singapore Dollar (SGD) ^a		US Dollar (USD) ^b	
									Individual Cost \$	Total Sample \$	Individual Cost \$	Total Sample \$
22	July	2018	F	>90	Whole	No	JFP	--	--	15	--	11.26
			F	>90	Tailed	No	JFP	--	--	--	--	--
			M	>90	Tailed	No	SFP	Indonesia	22.8	--	17.11	17.11
			F	>90	Tailed	No	SFP	Malaysia	--	16	--	12.01
			F	>90	Whole	Yes	SFP	Malaysia	--	--	--	--
			F	>90	Whole	Yes	SFP	Malaysia	--	--	--	--
			F	>90	Whole	Yes	SFP	Malaysia	--	--	--	--
28	July	2018	M	<100	Tailed	No	SFP	Indonesia	44	--	33.03	33.03
			M	--	Tailed	No	JFP	Indonesia	--	26.4	--	19.82
			F	--	Tailed	No	JFP	Indonesia	--	--	--	--
			M	<100	Tailed	No	JFP	Indonesia	45	--	33.78	33.78
			M	<100	Tailed	No	JFP	Indonesia	--	120	--	90.09
			M	<100	Tailed	No	JFP	Indonesia	--	--	--	--
			F	>90	Tailed	No	JFP	Indonesia	--	--	--	--
20	October	2018	--	>90	Tailed	No	JFP	Indonesia	--	218	--	163.67
			--	>90	Tailed	No	JFP	Indonesia	--	--	--	--
			--	>90	Tailed	No	JFP	Indonesia	--	--	--	--
			--	>90	Tailed	No	JFP	Indonesia	--	--	--	--
			--	>90	Tailed	No	JFP	Indonesia	--	--	--	--
			--	>90	Tailed	No	JFP	Indonesia	--	--	--	--
1	December	2018	--	>90	Tailed	No	JFP	--	--	176	--	132.13
			--	>90	Tailed	No	JFP	--	--	--	--	--

Section S2. Length conversion analysis

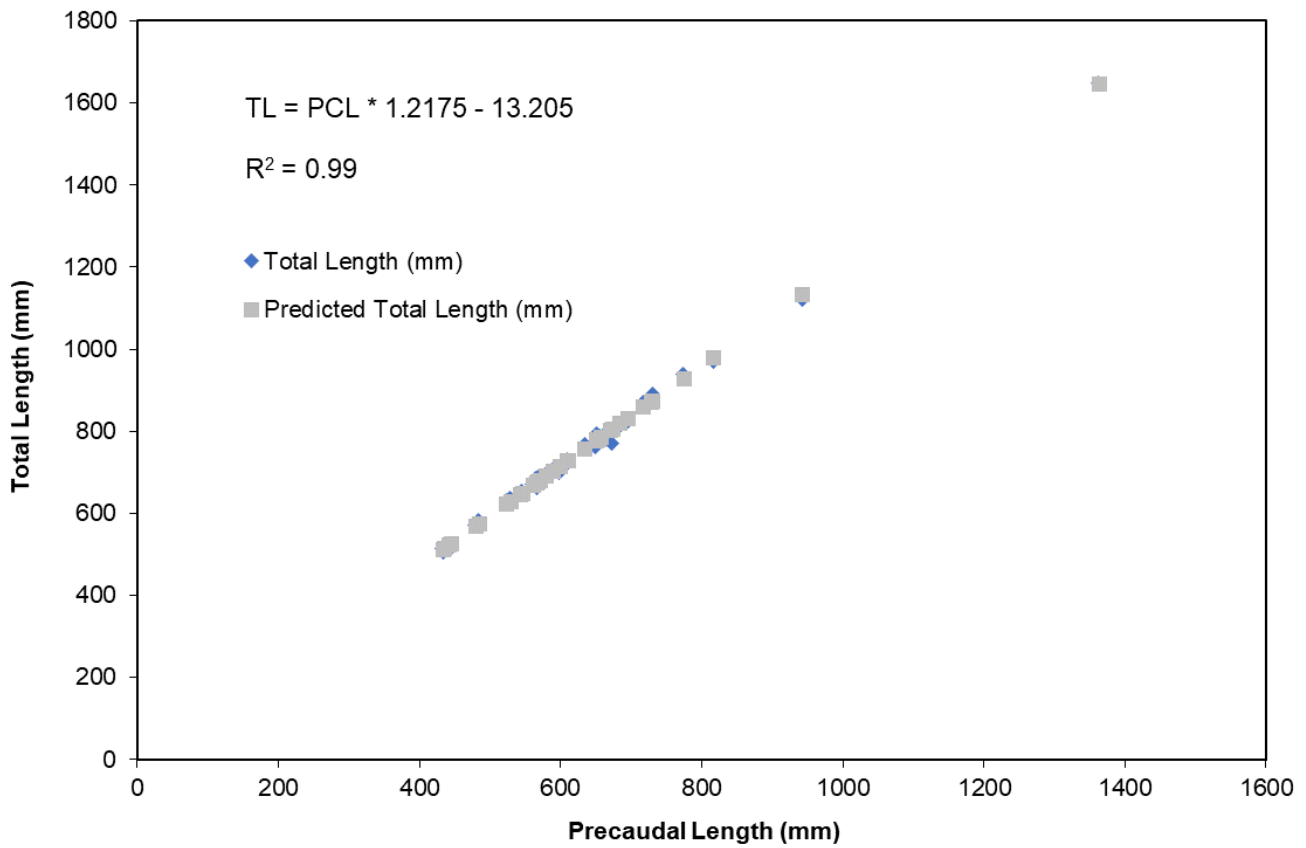


Figure S1. Linear relationship for bottlenose wedgefish *Rhynchobatus australiae*, between the pre-caudal length and total length measurements to convert pre-caudal length measures to predicted total length using the conversion equation $TL = PCL * 1.2175 - 13.205$.

Table S2. Data for the length conversion analysis for bottlenose wedgefish *Rhynchobatus australiae*, with information on the sex (F, female; M, male), total length in millimetres (mm TL); fork length (FL); precaudal length (PCL); sample location; predicted total length using the conversion equation $TL = PCL * 1.2175 - 13.205$ and the calculated residuals; -- indicate information was not recorded/available.

Species	Sex	TL (mm)	FL (mm)	PCL (mm)	Sample location	Predicted TL (mm)	Residuals	Reference
<i>Rhynchobatus australiae</i>	F	524	480	444	northern Australia	527.2732709	-3.27327	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	M	571	521	479	northern Australia	569.8864334	1.11357	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	F	583	531	484	northern Australia	575.9740281	7.02597	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	M	632	577	523	northern Australia	623.4572664	8.54273	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	M	638	582	529	northern Australia	630.7623799	7.23762	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	M	650	603	543	northern Australia	647.807645	2.19236	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	M	653	600	545	northern Australia	650.2426828	2.75732	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	M	661	611	566	northern Australia	675.8105804	-14.8106	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	F	670	618	560	northern Australia	668.5054668	1.49453	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	M	684	623	570	northern Australia	680.6806561	3.31934	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	F	686	630	565	northern Australia	674.5930614	11.4069	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	M	687	632	568	northern Australia	678.2456182	8.75438	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	F	696	641	579	northern Australia	691.6383264	4.36167	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	M	707	647	589	northern Australia	703.8135158	3.18648	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	M	721	660	609	northern Australia	728.1638944	-7.16389	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	F	730	670	610	northern Australia	729.3814133	0.61859	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	F	769	705	634	northern Australia	758.6018676	10.3981	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	F	789	721	656	northern Australia	785.3872841	3.61272	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	M	790	724	653	northern Australia	781.7347273	8.26527	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	F	792	721	651	northern Australia	779.2996894	12.7003	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	M	806	741	670	northern Australia	802.4325491	3.56745	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	F	814	736	684	northern Australia	819.4778141	-5.47781	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	F	826	765	695	northern Australia	832.8705223	-6.87052	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	F	870	789	717	northern Australia	859.6559388	10.3441	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	M	883	806	728	northern Australia	873.048647	9.95135	D'Alberto (2021) Unpublished data

<i>Rhynchobatus australiae</i>	F	889	798	730	northern Australia	875.4836849	13.5163	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	M	940	859	774	northern Australia	929.0545178	10.9455	D'Alberto (2021) Unpublished data
<i>Rhynchobatus australiae</i>	--	1648	--	1363	Indonesia	1646.173168	1.82683	White (2021) Unpublished data
<i>Rhynchobatus australiae</i>	F	969	894	816	Indonesia	980.1903129	-11.1903	This study
<i>Rhynchobatus australiae</i>	F	763	728	650	SE Asia	778.0821705	-15.0822	This study
<i>Rhynchobatus australiae</i>	F	772	731	673	Malaysia	806.0851059	-34.0851	This study
<i>Rhynchobatus australiae</i>	M	512	492	442	Malaysia	524.838233	-12.8382	This study
<i>Rhynchobatus australiae</i>	F	506	488	434	Malaysia	515.0980816	-9.09808	This study
<i>Rhynchobatus australiae</i>	F	513	483	433	Malaysia	513.8805627	-0.88056	This study
<i>Rhynchobatus australiae</i>	F	700	650	598	SE Asia	714.7711861	-14.7712	This study
<i>Rhynchobatus australiae</i>	M	1122	1030	942	SE Asia	1133.597698	-11.5977	This study

Section S3. Frequentist approach

Text S1. Frequentist approach

The frequentist growth curves were generated using the 'AquaticLifeHistory' package for the three growth models (Smart 2019). Best-fit parameter estimates with standard error estimates were generated for all three candidate models using the 'nls' function in the 'R' programme environment (R Core Team 2021).

Model performance evaluation and selection was conducted using the Akaike's information criterion (AIC) with a small sample size bias correction algorithm (AIC_c). The use of sample size adjusted bias correction is recommended for sample sizes less than 200 (Zhu et al. 2009). This sample size bias algorithm provides a measure of model fit and complexity, allowing for simultaneous comparisons of growth models (Natanson et al. 2014). AIC_c was calculated as follows:

$$AIC_c = AIC + \left(\frac{(2k(k+1))}{n-k-1} \right)$$

where $AIC = n \log(\sigma^2) + 2k$, k is the total number of parameters + 1 for variance (σ^2), and n is the sample size. The model with the lowest AIC_c value (AIC_{min}) was considered to best fit the data and the most appropriate model. The remaining models were ranked using the AIC difference (Δ) which was calculated for each model ($i = 1 - 3$) as follows:

$$\Delta_i = AIC_{c,i} - AIC_{min}$$

Models that had the highest support had Δ values from 0–2, whereas models where $\Delta = 2-10$ had substantially less support, and modes with little or no support had Δ values of >10 (Burnham & Anderson 2003). The probability of choosing the correct model from the set of candidate models was calculated using AIC weights (w) as:

$$w_i = \frac{\left(\exp\left(-\frac{\Delta_i}{2}\right) \right)}{\left(\sum_{j=1}^3 \exp\left(-\frac{\Delta_j}{2}\right) \right)}$$

Results

The von Bertalanffy growth model was the best fit for the observed length-at-age data based on the AIC_c weights (Table S3). A pronounced asymptote was not observed in growth curves from combined sexes, and the asymptotic length parameter was smaller than the known maximum length for *R. australiae* (Figure S2 A). The length at birth parameter was larger than the observed samples aged at zero years. The von Bertalanffy frequentist growth model estimated a growth completion rate of 0.14 yr⁻¹, and a theoretical longevity of 18.5 years (Table S3).

Separate growth curves for individual sexes were produced using the frequentist models. The von Bertalanffy growth model was the best fit for both female and male *R. australiae* (Table S3; Figure S2). Males were estimated to have a slower growth completion rate than females (Table S3; Figure S2 B, C). The estimated asymptotic length for females and males was

estimated to be smaller than the known maximum length. A pronounced asymptote was not observed in growth curve for females, while there was a slight asymptote for the males (Figure S2 B, C). The modelled sizes at birth for females and males was greater than the empirical size at birth of 512mm from this study (Table S3).

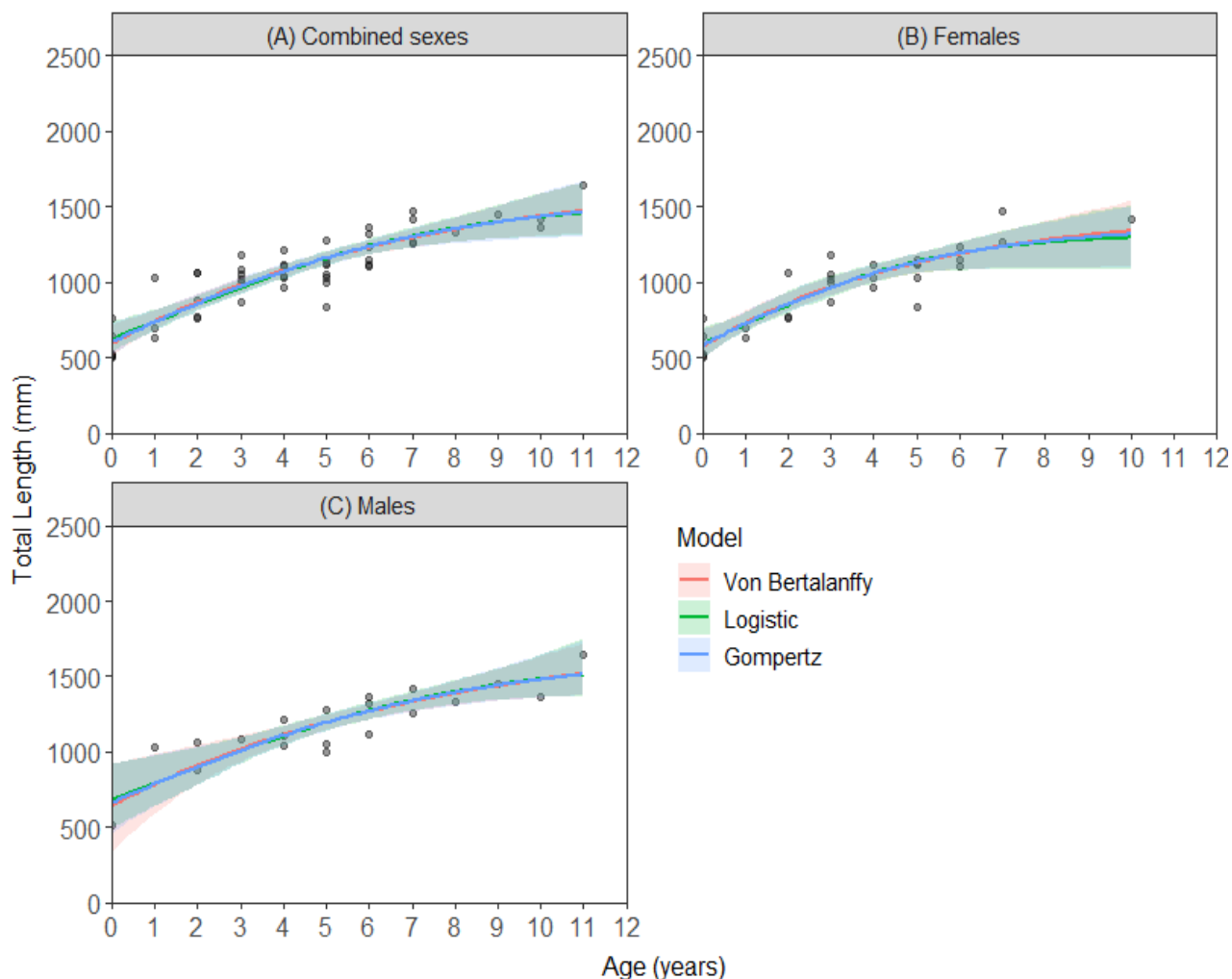


Figure S2. Multi-model length-at-age growth curves for bottlenose wedgefish *Rhynchobatus australiae* generated by the Frequentist growth modelling approach for **(A)** combined sexes ($n = 48$), **(B)** females ($n = 28$) and **(C)** males ($n = 20$), sampled from Senoko Fishery Port (SFP) and Jurong Fishery Port (JFP) in Singapore from September 2017 to September 2018, and January 2019 to January 2020.

Table S3. Summary of Frequentist model parameter estimates and Akaike’s information criterion corrected for small sample size (AICc) performance of the three models used for the combined (females and males) and separate sexes observed length-at-age data (with removed outlier) for bottlenose wedgefish *Rhynchobatus australiae* from Singapore Fish Markets, sampled between October 2018 – August 2019. The best fitting model is highlighted in bold; VBGF, the von Bertalanffy growth function; n , sample size; Δ , difference between AICc values; w , AICc weights; L_{∞} , asymptotic length mm total length (TL); S.E., standard error; k , von Bertalanffy growth completion rate; g , Gompertz/Logistic growth completion rate; L_0 , length-at-birth mm TL.

	Model	Model Performance				Model Parameter Estimates						Theoretical Longevity
		n	AICc	Δ	w	L_{∞} (mm TL)	\pm S.E.	k/g (yr ⁻¹)	\pm S.E.	L_0 (mm TL)	\pm S.E.	
Combined	VBGF	48	605.3	0.00	0.51	1711.9	240.1	0.14	0.05	597.8	48.0	18.54
	Logistic	48	607.4	2.04	0.18	1535.5	121.2	0.30	0.06	628.0	44.3	
	Gompertz	48	606.3	1.00	0.31	1592.6	154.8	0.22	0.06	613.2	46.0	
Females	VBGF	28	356.2	0.00	0.43	1471.2	233.8	0.19	0.09	577.1	56.1	16.34
	Logistic	28	357.4	1.19	0.24	1325.3	116.9	0.41	0.12	591.7	53.8	
	Gompertz	28	356.7	0.55	0.33	1379.6	153.6	0.30	0.10	584.7	54.7	
Males	VBGF	20	256.3	0.00	0.36	1781.7	358	0.13	0.08	649.1	99.6	19.13
	Logistic	20	256.6	0.33	0.31	1615.2	185.9	0.27	0.09	684.7	88.8	
	Gompertz	20	256.5	0.20	0.33	1674.8	240.9	0.2	0.08	669	93.8	

Section S4. Genetic sequencing for species identification

Table S4. The results of the genetic sequencing for the species identification for wedgefish samples (WSG) collected from two fish markets in Singapore. The sequencing was compared to three species, bottlenose wedgefish *Rhynchobatus australiae*, broadnose wedgefish *Rhynchobatus springeri* and eyebrow wedgefish *Rhynchobatus palpebratus*. A match of over 99% (in bold) indicated the species identification. Three samples did not have conclusion genetic species identification (*) and were visually identified by an elasmobranch taxonomic expert (W.T.W) as *R. australiae*.

Species code	ID number	Percentage match to species		
		<i>R. australiae</i>	<i>R. springeri</i>	<i>R. palpebratus</i>
WSG	138214	99.3	95.7	95.6
WSG	138215	99.4	95.6	95.4
WSG	138216	99.6	95.4	95.3
WSG	138217	99.4	95.6	95.1
WSG	138218	99.6	95.7	96.0
WSG	148530	98.9	95.7	97.9
WSG	148531	99.0	95.4	95.7
WSG	148532	99.1	95.9	95.7
WSG	148533	99.3	96.0	97.1
WSG	148534	99.1	95.8	96.9
WSG	148535	99.6	95.7	95.3
WSG	148536	96.2	97.2	99.1
WSG	148537	100.0	96.0	95.6
WSG	148539	99.5	95.8	96.9
WSG	148541	99.1	95.6	95.7
WSG	148542	99.1	95.6	95.4
WSG	148543	99.2	96.1	97.1
WSG	148545	99.1	96.6	95.7
WSG	148548	99.5	95.8	95.3
WSG	148549	99.6	95.7	95.3
WSG	148550	99.6	95.7	95.3
WSG	148551	99.5	95.8	96.9
WSG	148552	99.3	96.0	95.6
WSG	148553	99.2	96.0	95.1
WSG	150337	99.4	96.6	95.5
WSG	150338	99.3	95.8	95.8
WSG	195072	99.4	95.7	95.4
WSG	195074	98.7	96.3	96.2
WSG	195075	99.1	95.8	96.9
WSG	195076	99.4	95.6	95.4
WSG	195077	99.3	95.4	95.6
WSG	195078	95.7	97.5	99.1
WSG	195079	99.3	95.9	95.3
WSG	195080	99.0	95.7	95.9
WSG	195081	99.1	95.6	95.6
WSG	195082	99.3	95.8	95.5
WSG	195083	99.6	95.7	95.3
WSG	195084	99.6	95.4	95.3

WSG	195085	99.6	95.8	95.2
WSG	195086	99.6	95.7	95.3
WSG	195087	99.4	95.6	95.4
WSG	195088*	96.6	96.3	96.4
WSG	195089*	97.2	96.4	96.7
WSG	195090*	96.7	96.6	96.7
WSG	195091	99.4	95.6	95.4
WSG	198597	99.0	95.9	96.9

Section S5. Bayesian Model Diagnostics

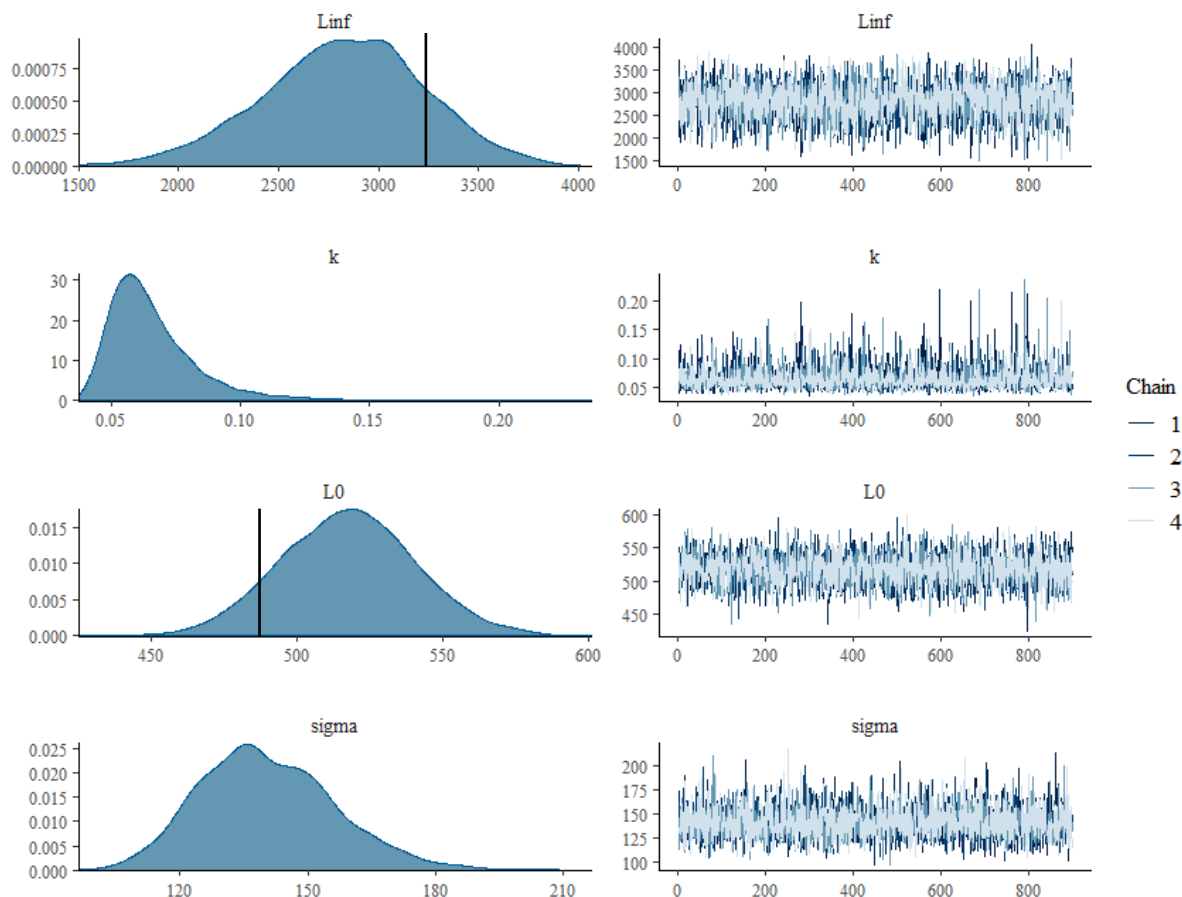


Figure S3. Parameter posterior distributions (left) with informative priors (black vertical line for asymptotic length L_{inf} and length at birth L_0), and MCMC chain convergence (right) for bottlenose wedgefish *Rhynchobatus australiae* combined sexes priors for the von Bertalanffy growth function (VBGF). Four MCMC chains with 10,000 iterations were set as 10000, with burn in of 1000 iterations, chain of 4 and thinning rate of 10. Normally distributed informative priors (μ , black line) with normal residual error structure (σ) were set at $L_{inf} \sim N(3230, 323)$ and $L_0 \sim N(488, 25)$. The lower and upper bounds of the non-informative uniform distributions of VBGF growth completion rate k was set as 0 and 1.0 year^{-1} respectively. The upper bound of the non-informative uniform distribution of σ was set as 1000.

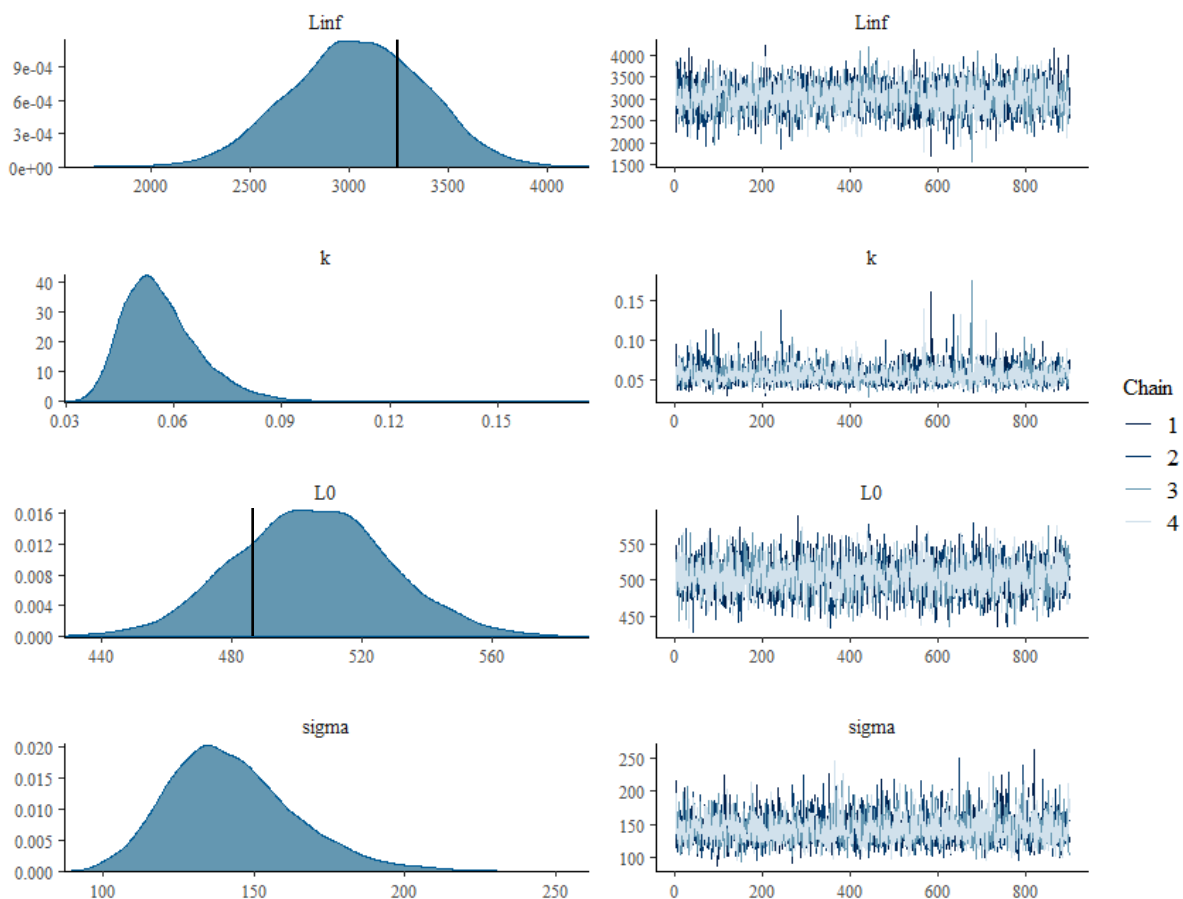


Figure S4. Parameter posterior distributions (left) with informative priors (black vertical line for asymptotic length L_{inf} and length at birth L_0), and MCMC chain convergence (right) for bottlenose wedgfish *Rhynchobatus australiae* female only priors for the von Bertalanffy growth function (VBGF). Four MCMC chains with 10,000 iterations were set as 10000, with burn in of 1000 iterations, chain of 4 and thinning rate of 10. Normally distributed informative priors (μ , black line) with normal residual error structure (σ) were set at $L_{inf} \sim N(3230, 323)$ and $L_0 \sim N(488, 25)$. The lower and upper bounds of the non-informative uniform distributions of VBGF growth completion rate k was set as 0 and 1.0 year⁻¹ respectively. The upper bound of the non-informative uniform distribution of σ was set as 1000.

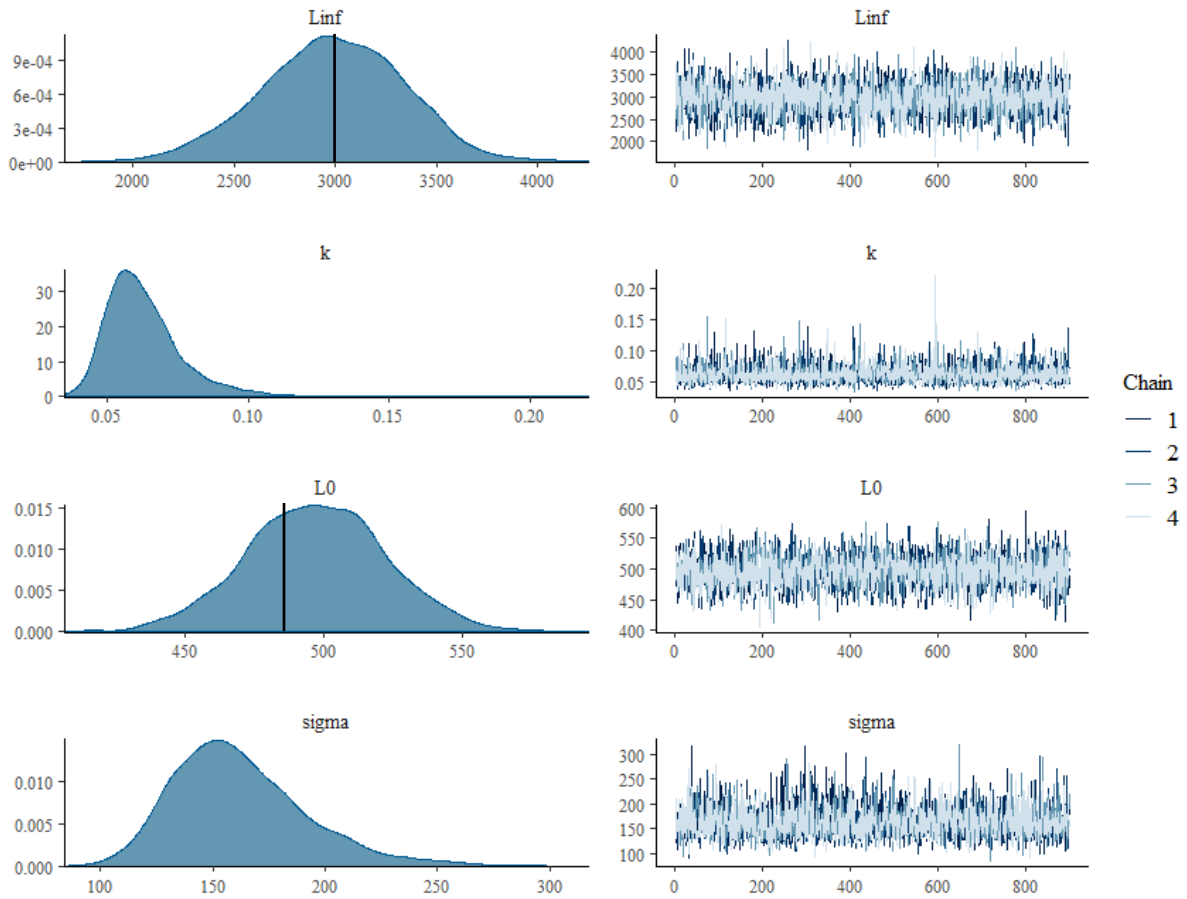


Figure S5. Parameter posterior distributions (left) with informative priors (black vertical line for asymptotic length L_{inf} and length at birth L_0), and MCMC chain convergence (right) for bottlenose wedgefish *Rhynchobatus australiae* males only priors for the von Bertalanffy growth function (VBGF). Four MCMC chains with 10,000 iterations were set as 10000, with burn in of 1000 iterations, chain of 4 and thinning rate of 10. Normally distributed informative priors (μ , black vertical line) with normal residual error structure (σ) were set at $L_{inf} \sim N(3000, 300)$ and $L_0 \sim N(488, 25)$. The lower and upper bounds of the non-informative uniform distributions of VBGF growth completion rate k was set as 0 and 1.0 year⁻¹ respectively. The upper bound of the non-informative uniform distribution of sigma was set as 1000.

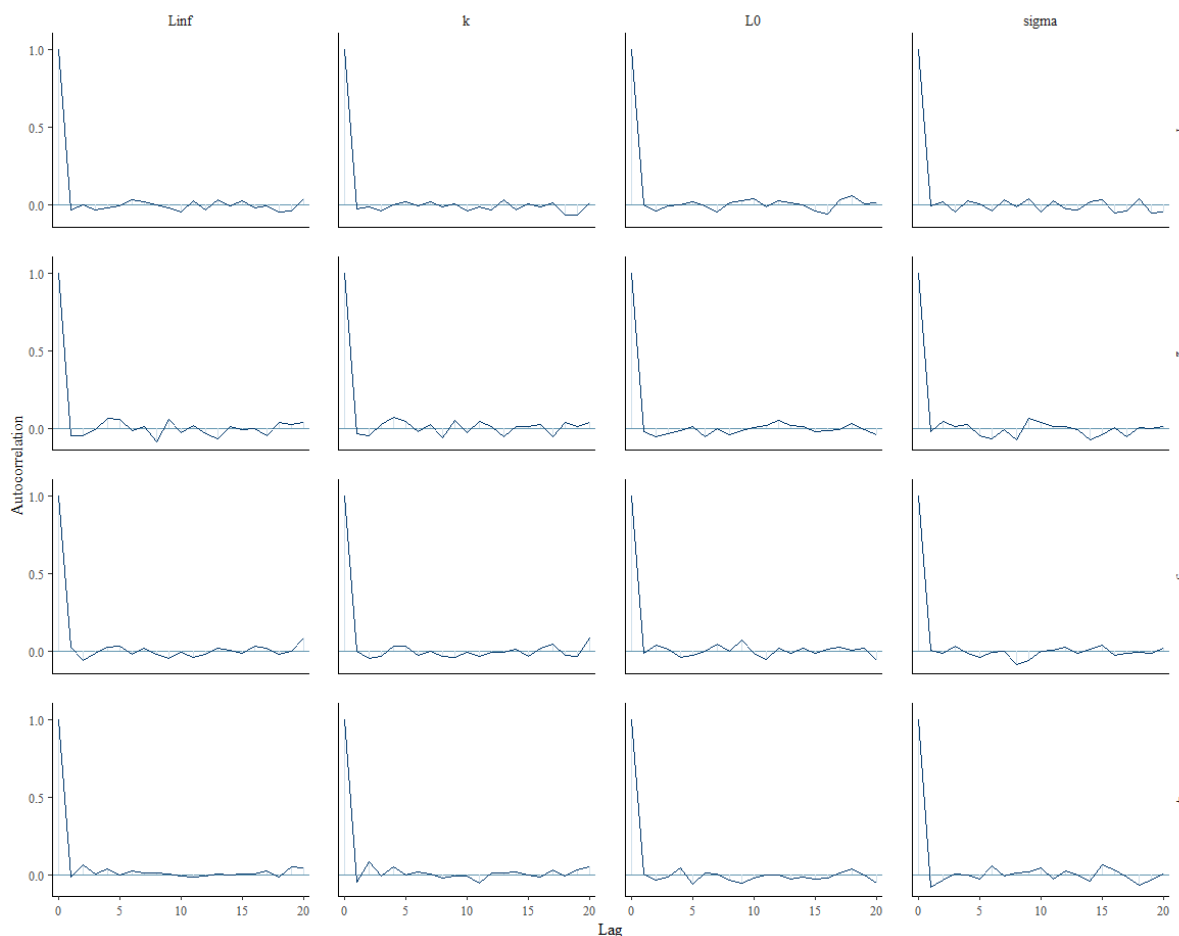


Figure S6. Autocorrelation lag plots for bottlenose wedgefish *Rhynchobatus australiae* combined sexes priors for the von Bertalanffy growth function (VBGF). Four MCMC chains with 10,000 iterations were set as 10000, with burn in of 1000 iterations, chain of 4 and thinning rate of 10. Normally distributed informative priors (μ) with normal residual error structure (σ) were set at asymptotic length $L_{inf} \sim N(3230, 323)$ and length at birth $L_0 \sim N(488, 25)$. The upper bounds of the non-informative uniform distributions of sigma and VBGF growth completion rate k was set as 1000 and 1.0 year^{-1} respectively.

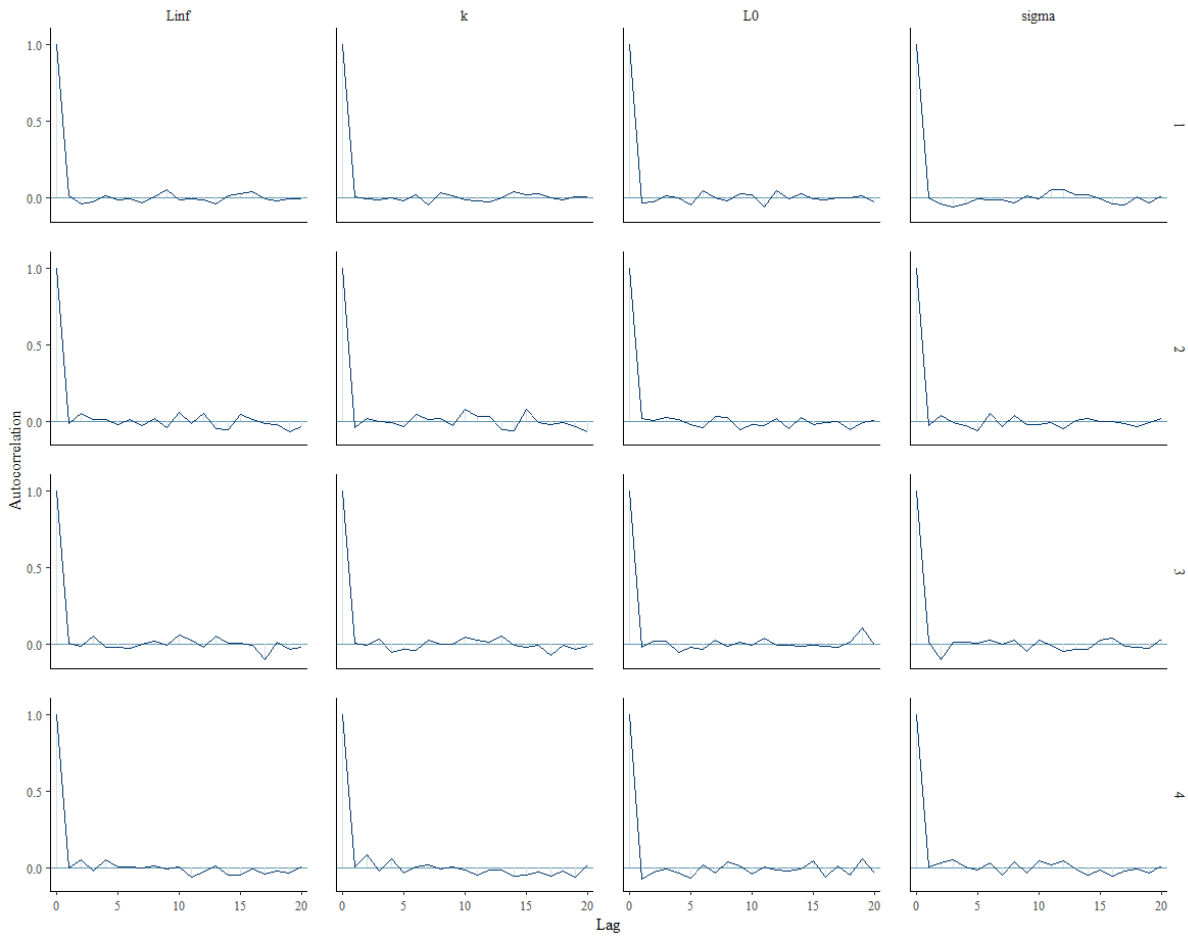


Figure S7. Autocorrelation lag plots for bottlenose wedgefish *Rhynchobatus australiae* female only priors for the von Bertalanffy growth function (VBGF). Four MCMC chains with 10,000 iterations were set as 10000, with burn in of 1000 iterations, chain of 4 and thinning rate of 10. Normally distributed informative priors (μ) with normal residual error structure (σ) were set at asymptotic length $L_{inf} \sim N(3230, 323)$ and length at birth $L_0 \sim N(488, 25)$. The upper bounds of the non-informative uniform distributions of sigma and VBGF growth completion rate k was set as 1000 and 1.0 year^{-1} respectively.

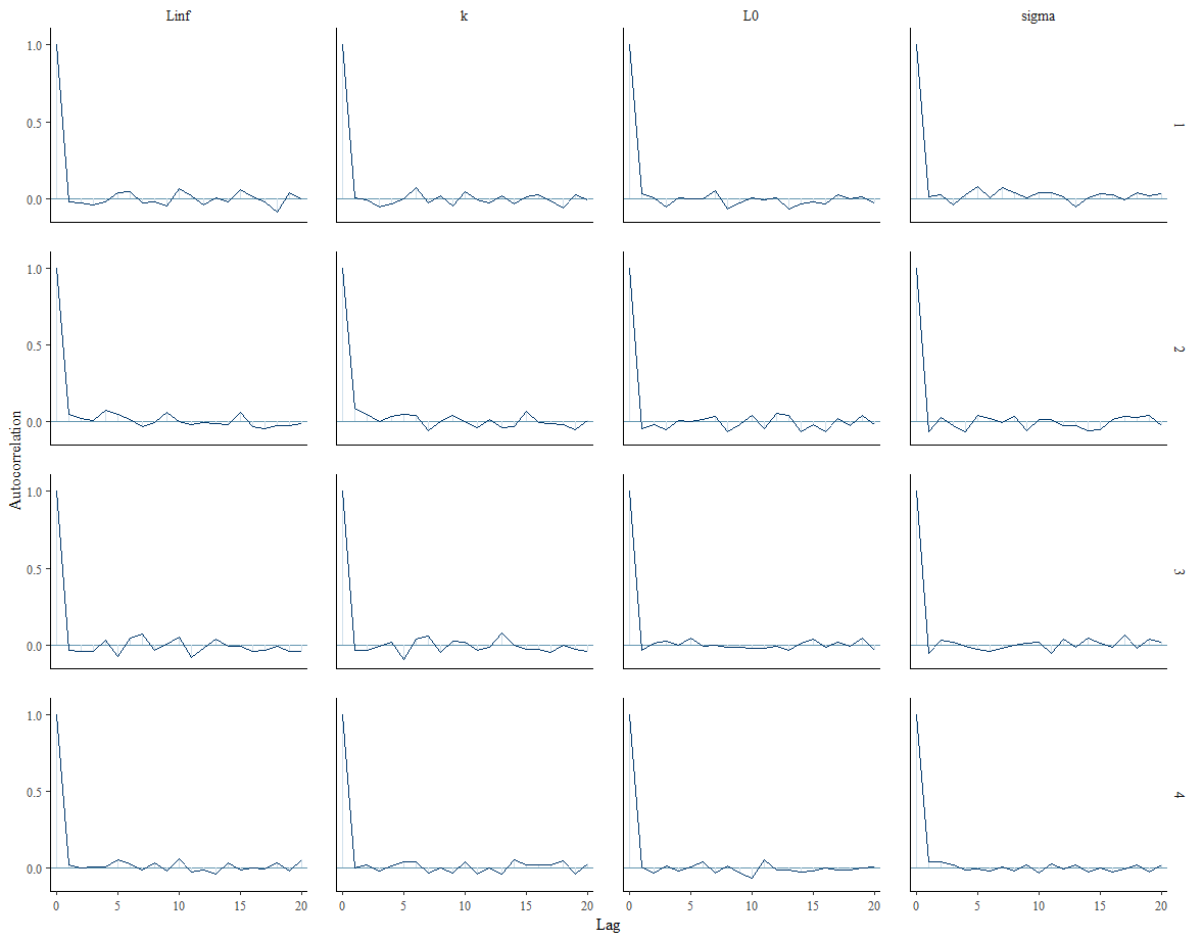


Figure S8. Autocorrelation lag plots for bottlenose wedgefish *Rhynchobatus australiae* male only priors for the von Bertalanffy growth function (VBGF). Four MCMC chains with 10,000 iterations were set as 10000, with burn in of 1000 iterations, chain of 4 and thinning rate of 10. Normally distributed informative priors (μ) with normal residual error structure (σ) were set at asymptotic length $L_{inf} \sim N(3230, 323)$ and length at birth $L_0 \sim N(488, 25)$. The upper bounds of the non-informative uniform distributions of sigma and VBGF growth completion rate k was set as 1000 and 1.0 year^{-1} respectively.

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