Appendix E. Within-area supplementary results: result descriptions, model selection tables and within-area intrinsic effect plots

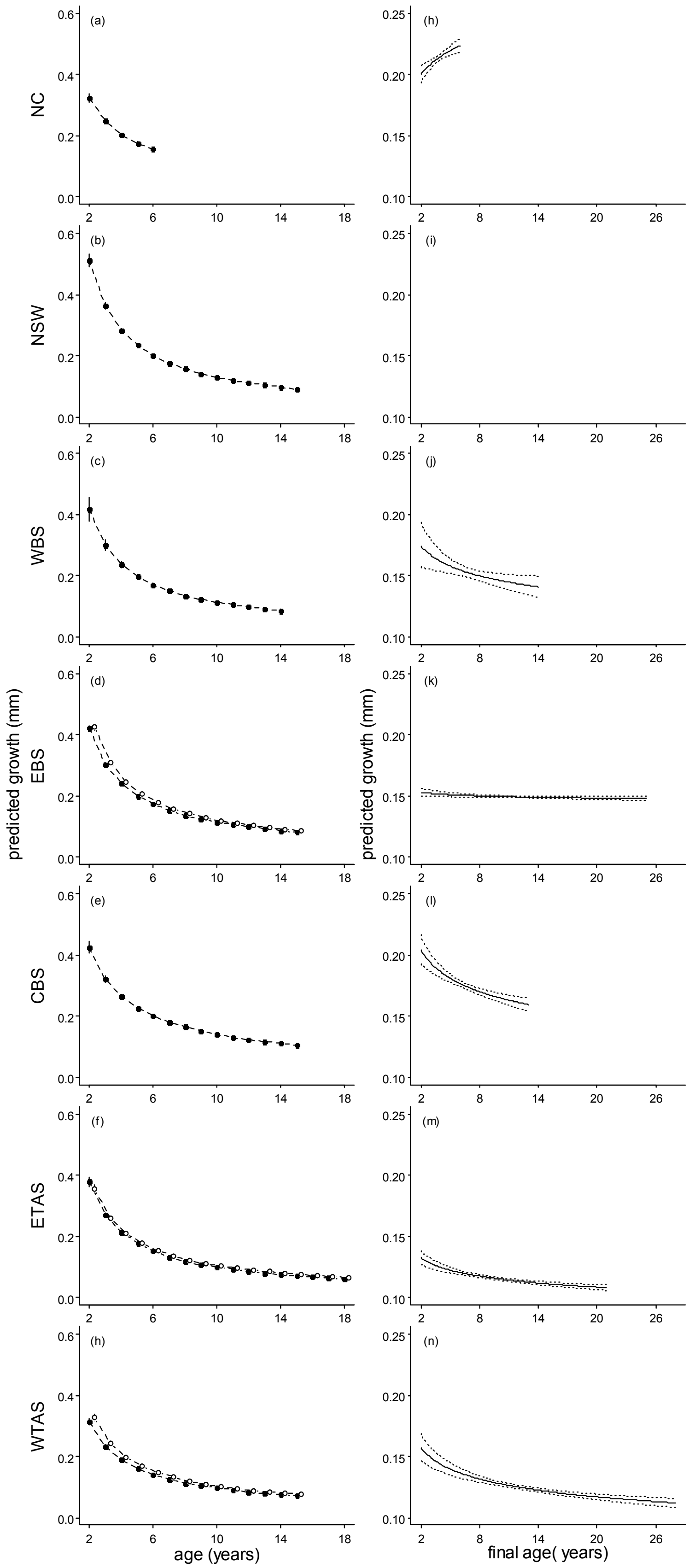
Text E1: Best random effect structures for each area

There was considerable diversity in the best models selected for each area (Table 3, main text). Despite the low levels of growth synchrony amongst individuals, the best models from six of the seven areas included a *Year* and/or *Cohort* random intercept. In NC and WTAS, the base model (Model 1b) was improved through the addition of both *Year* and *Cohort* random intercepts (Model 4a). The best NSW model included a random *Age* slope for each *Year* and a *Cohort* random intercept (Model 4b) whilst the best EBS model included a random *Age* slope for each *Cohort* and a *Year* random intercept (Model 4c). Conversely, WBS, CBS and ETAS models were relatively simpler. The base model was improved in ETAS through the addition of a random *Age* slope for each *Year* (Model 3a), in WBS through the addition of just a *Year* random intercept (Model 2a), but in CBS additional random effects did not improve model fit (Model 1b).

Table E1: Results of intrinsic effects model selection for each area based on the full data set. Each model was fitted with ML and their relative importance in explaining annual growth variation assessed using AIC_c. Best models highlighted in bold. $R^2_{LMM(m)}$ (marginal R^2 variance explained by just fixed factors) and $R^2_{LMM(c)}$ (conditional R^2variance explained by fixed and random factors) were calculated for models fit with REML.

area	model	df	AIC_c	ΔAIC_c	log likelihood	$R^2_{LMM(m)}$	$R^2_{LMM(c)}$
NC	age	8	-890.9	5.64	453.56	0.505	0.879
	age + sex	9	-890.65	5.9	454.47	0.505	0.879

	age + final age	**9**	**-896.54**	**0**	**457.41**	**0.472**	**0.858**
	age * sex	10	-888.58	7.96	454.47	0.505	0.880
	age + sex + final age	10	-896.09	0.46	458.22	0.471	0.859
	age * sex + final age	11	-894.02	2.52	458.22	0.472	0.859
NSW	**age**	**10**	**-380.3**	**0**	**200.21**	**0.643**	**0.802**
	age + sex	11	-378.9	1.4	200.52	0.686	0.810
	age + final age	11	-373.35	6.95	197.74	0.695	0.809
	age * sex	12	-369.95	10.34	197.06	0.642	0.802
	age + sex + final age	12	-379.14	1.16	201.65	0.660	0.804
	age * sex + final age	13	-369.51	10.78	197.85	0.660	0.804
WBS	age	7	-31.8	2.02	23.09	0.744	0.793
	age + sex	8	-29.87	3.95	23.18	0.743	0.793
	age + final age	**8**	**-33.82**	**0**	**25.15**	**0.751**	**0.789**
	age * sex	9	-30.11	3.71	24.35	0.744	0.793
	age + sex + final age	9	-31.7	2.12	25.15	0.750	0.789
	age * sex + final age	10	-31.82	2.01	26.28	0.750	0.789
EBS	age	10	-951.96	35.75	485.99	0.689	0.751
	age + sex	11	-986.02	1.7	504.02	0.687	0.753
	age + final age	11	-953.39	34.32	487.7	0.690	0.753
	age * sex	12	-986.45	1.26	505.24	0.688	0.753
	age + sex + final age	12	-987.4	0.31	505.71	0.690	0.753
	age * sex + final age	**13**	**-987.71**	**0**	**506.87**	**0.691**	**0.753**
CBS	age	6	150.54	30.16	-69.24	0.608	0.633
	age + sex	7	152.47	32.09	-69.2	0.608	0.633
	age + final age	**7**	**120.38**	**0**	**-53.15**	**0.623**	**0.646**
	age * sex	8	154.02	33.63	-68.96	0.608	0.633
	age + sex + final age	8	151.2	30.82	-67.55	0.624	0.647
	age * sex + final age	9	122.12	1.74	-52	0.624	0.647
ETAS	age	9	-36.33	16.36	27.2	0.785	0.826
	age + sex	10	-37.17	15.52	28.63	0.785	0.826
	age + final age	10	-42.87	9.82	31.47	0.792	0.830
	age * sex	11	-46.2	6.5	34.14	0.785	0.825
	age + sex + final age	11	-43.21	9.48	32.65	0.792	0.829
	age * sex + final age	**12**	**-52.7**	**0**	**38.4**	**0.792**	**0.829**
WTAS	age	8	80.32	30.46	-32.12	0.731	0.766
	age + sex	9	72.19	22.34	-27.05	0.737	0.767
	age + final age	9	60.29	10.43	-21.09	0.748	0.773
	age * sex	10	74.09	24.23	-26.98	0.737	0.767
	age + sex + final age	**10**	**49.86**	**0**	**-14.86**	**0.752**	**0.774**
	age * sex + final age	11	51.86	2.01	-14.86	0.752	0.774



(a)
(b)
(c)
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(k)
(l)
(m)
(n)
NC
NSW
WBS
EBS
CBS
ETAS
WTAS
predicted growth (mm)
predicted growth (mm)
age (years)
final age(years)

Figure E1: Predicted annual growth variation in tiger flathead across seven fishing areas (± 95% CI). (a-g) area-specific age and where present, sex (male closed circle, female open circle, females offset on x axis for clarity), related trends. (h-m) area-specific age-at-capture related trends. Note, age-at-capture not included in best model for NSW.

Table E2: Results of temporal trend model selection for each area based on the full data set. Test descriptions as per table D1. Best models highlighted in bold.

area	model	df	AIC_c	ΔAIC_c	log likelihood	$R^2_{LMM(m)}$	$R^2_{LMM(c)}$
NC	***intrinsic effects***	**11**	**-892.42**	**0**	**457.42**	0.469	0.858
	+ Year	12	-890.520	1.9	457.51	0.458	0.858
NSW	*intrinsic effects*	10	-380.300	38.41	200.21	0.643	0.802
	+ Year	**11**	**-418.710**	**0**	**220.42**	0.779	0.803
WBS	*intrinsic effects*	8	-33.82	1.89	25.15	0.751	0.789
	+ Year	**9**	**-35.71**	**0**	**27.16**	0.748	0.782
EBS	*intrinsic effects*	13	-987.710	27.39	506.87	0.691	0.753
	+ Year	**14**	**-1015.100**	**0**	**521.57**	0.693	0.738
CBS	***intrinsic effects***	**7**	**120.380**	**0**	**-53.15**	0.623	0.646
	+ Year	8	121.080	0.7	-52.49	0.624	0.647
ETAS	*intrinsic effects*	12	-52.700	20.15	38.4	0.792	0.829
	+ Year	**13**	**-72.850**	**0**	**49.49**	0.796	0.827
WTAS	*intrinsic effects*	10	49.86	5.61	-14.86	0.752	0.774
	+ Year	11	44.25	0	-11.05	0.754	0.776

Table E3: Results of temperature effects model selection for each area based on the full data set. Test descriptions as per table D1. Best models highlighted in bold. Note *Temperature²* includes linear *Temperature* term.

area	**model**	**Df**	**AIC$_c$**	**ΔAIC$_c$**	**log likelihood**	$R^2_{LMM(m)}$	$R^2_{LMM(c)}$
NC	*intrinsic effects*	9	-896.54	3.77	457.41	0.472	0.858
	+ *Temperature*	10	-899.67	0.65	460.01	0.482	0.863
	+ *Temperature2*	**11**	**-900.32**	**0**	**461.37**	0.479	0.865
	+ *Temperature*Age*	11	-897.61	2.71	460.01	0.482	0.862
	+ *Temperature*Age+Temperature2*	12	-899.49	0.83	461.99	0.486	0.866
NSW	*intrinsic effects*	10	-374.97	5.21	196.53	0.686	0.811
	+ *Temperature*	**11**	**-380.18**	**0**	**200.15**	**0.713**	**0.813**
	+ *Temperature2*	12	-378.19	1.99	200.17	0.710	0.814
	+ *Temperature*Age*	12	-378.2	1.98	200.17	0.713	0.813
	+ *Temperature*Age+Temperature2*	13	-376.2	3.98	200.18	0.710	0.814
WBS	*intrinsic effects*	8	-33.82	1.02	25.15	0.751	0.789
	+ *Temperature*	**9**	**-34.84**	**0**	**26.72**	0.755	0.791
	+ *Temperature2*	10	-33.23	1.61	26.98	0.754	0.791
	+ *Temperature*Age*	10	-32.75	2.09	26.74	0.755	0.790
	+ *Temperature*Age+Temperature2*	11	-31.13	3.71	27.01	0.753	0.790
EBS	*intrinsic effects*	13	-987.71	5.66	506.87	0.691	0.753
	+ *Temperature*	**14**	**-993.37**	**0**	**510.7**	0.701	0.753
	+ *Temperature2*	15	-908.89	84.48	469.46	0.699	0.756
	+ *Temperature*Age*	15	-991.37	2	510.7	0.699	0.755
	+ *Temperature*Age+Temperature2*	16	-989.44	3.93	510.74	0.699	0.756
CBS	***intrinsic effects***	**7**	**120.38**	**0**	**-53.15**	0.623	0.646
	+ *Temperature*	8	122.34	1.96	-53.12	0.623	0.646
	+ *Temperature2*	9	124.06	3.68	-52.97	0.623	0.646
	+ *Temperature*Age*	9	123.32	2.94	-52.6	0.624	0.647
	+ *Temperature*Age+Temperature2*	10	125.32	4.94	-52.58	0.624	0.646
ETAS	*intrinsic effects*	12	-52.7	3.81	38.4	0.792	0.829
	+ *Temperature*	**13**	**-56.51**	**0**	**41.32**	0.797	0.829
	+ *Temperature2*	14	-55.24	1.27	41.69	0.794	0.829
	+ *Temperature*Age*	14	-54.78	1.73	41.46	0.794	0.829
	+ *Temperature*Age+Temperature2*	15	-53.5	3.01	41.84	0.794	0.829
WTAS	*intrinsic effects*	10	49.86	5.27	-14.86	0.752	0.774
	+ *Temperature*	**11**	**44.59**	**0**	**-11.92**	0.753	0.774
	+ *Temperature2*	12	47.45	2.86	-11.64	0.752	0.774
	+ *Temperature*Age*	12	45.98	1.4	-10.2	0.752	0.775
	+ *Temperature*Age+Temperature2*	13	46.27	1.68	-10.03	0.752	0.775

Table E4: Results of temperature and CPUE model selection for each area based on the restricted data set. Test description as per table D1. Only models ΔAIC<2 shown. Best models highlighted in bold. Full model: intrinsic effects + age*CPUE + age*temperature + temperature^2. Note *Temperature^2* includes linear *Temperature* term.

area	**model**	**Df**	**AIC$_c$**	**ΔAIC$_c$**	**log likelihood**	$R^2_{LMM(m)}$	$R^2_{LMM(c)}$
NC	*intrinsic effects*	9	-896.54	3.77	457.41	0.472	0.858
	+ Temperature	10	-899.67	0.65	460.01	0.482	0.863
	+ CPUE + Temperature	11	-899.01	1.31	460.71	0.474	0.861
	+ Temperature^2	**11**	**-900.32**	**0**	**461.37**	**0.479**	**0.865**
	+ CPUE + Temperature^2	12	-898.34	1.98	461.42	0.474	0.863
	*+ Temperature*Age+Temperature^2*	12	-899.49	0.83	461.99	0.486	0.866
NSW	*intrinsic effects*	9	-375.15	3.97	196.62	0.684	0.812
	+ Temperature	**10**	**-379.12**	**0**	**199.62**	**0.710**	**0.814**
	+ CPUE + Temperature	11	-377.29	1.83	199.72	0.707	0.813
	*+ Temperature*Age*	11	-377.2	1.92	199.67	0.709	0.813
WBS	*intrinsic effects*	8	-33.82	2.21	25.15	0.751	0.789
	+ Temperature	9	-34.84	1.20	26.72	0.755	0.791
	+ CPUE + Temperature	10	-34.91	1.12	27.82	0.742	0.760
	+ CPUE	**9**	**-36.03**	**0**	**27.32**	**0.744**	**0.760**
EBS	*intrinsic effects*	13	-865.93	5.64	445.98	0.687	0.758
	+ Temperature	14	-871.58	0	449.8	0.694	0.760
	*+ Temperature*Age*	15	-870.85	0.73	450.44	0.694	0.760
	+ CPUE + Temperature	15	-869.89	1.69	449.96	0.694	0.762
	+ Temperature^2	15	-869.59	1.99	449.81	0.692	0.761
CBS	*intrinsic effects*	7	120.38	2.35	-53.15	0.623	0.646
	+ CPUE + Temperature	9	119.80	1.77	-50.84	0.625	0.648
	+ CPUE	8	118.34	0.31	-51.12	0.625	0.648
	+ CPUE + Temperature^2	**10**	**118.03**	**0**	**-48.94**	**0.626**	**0.648**
	*+ CPUE *Age + Temperature^2*	11	119.99	1.96	-48.90	0.626	0.648
	*+ CPUE + Temperature*Age + Temperature^2*	11	119.89	1.86	-48.85	0.626	0.648
ETAS	*intrinsic effects*	12	-116.47	4.7	70.30	0.797	0.834
	+ Temperature	**13**	**-121.18**	**0**	**73.66**	**0.799**	**0.835**
	+ CPUE + Temperature	14	-119.91	1.27	74.03	0.799	0.834
	+ Temperature^2	14	-119.88	1.29	74.02	0.799	0.835
	*+ Temperature*Age*	14	-119.67	1.5	73.92	0.799	0.835
WTAS	*intrinsic effects*	10	183.31	0.88	-81.75	0.678	0.719
	+ CPUE*Age + Temperature*Age	**14**	**182.95**	**0**	**-77.16**	**0.689**	**0.725**
	*+ CPUE + Temperature*Age + Temperature^2*	15	184.87	1.91	-77.07	0.687	0.725

Text E2: Description of short-term data set results

Annual growth was positively related to *Temperature* in NSW, EBS and ETAS (biochronologies 5, 11 and 6 years shorter in length respectively) and curve-linearly so in NC (same length). Of note was the loss of a *Temperature* trend in WTAS, likely due to the biochronology being 18 years shorter in length. The addition of an *Abundance* term improved the fit of two zones' models. In WBS, *Annual growth* was negatively related to *Abundance* ($t= 2.58$, $\beta = -0.316 \pm 0.123$ SE) and replaced a weak negative temperature effect (Table 5c). In CBS, the addition of *Abundance* (positively related to *Annual growth* $t= 2.84$, $\beta = 0.251 \pm 0.089$ SE) also resulted in a marginal positive curve-linear temperature effect that was consistent with patterns seen in other zones (*Temperature:* $t= 1.64$, $\beta = 0.075 \pm 0.046$ SE, *Temeprature*^{2}: $t= 1.95$, $\beta = 0.458 \pm 0.236$ SE).